U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
PB-279 831

A Primer on Auto Emissions Systems for Home Mechanics

Colorado State Univ, Fort Collins Dept of Industrial Sciences

Prepared for

Environmental Protection Agency, Research Triangle Park, N C Control Programs Development Div

Nov 77

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-450/3-77-043	2.	3. RECIPIENT'S ACCESSION NO. PB279831
4. TITLE AND SUBTITLE A Primer on Auto Emissions Systems for Home Mechanics		5. REPORT DATE November 1977
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) B.D. Hayes M.T. Maness R.A. Ragazzi		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Department of Industrial Sciences Colorado State University Fort Collins, Colorado 80523		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO. T900621-01-0
12. SPONSORING AGENCY NAME AND ADDRESS Control Programs Development Division Office of Air Quality Planning and Standards Office of Air and Waste Management U.S. Environmental Protection Agency Research Triangle Park, N.C. 27711		13. TYPE OF REPORT AND PERIOD COVERED Final Report
		14. SPONSORING AGENCY CODE EPA 200/04

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This booklet has been designed to acquaint the average home mechanic with the basic emissions control systems and components installed on today's cars. It stresses the fact that emissions control equipment has been installed to reduce the amount of pollution discharged to the atmosphere from automobiles and thus protect the health of people.

The booklet is only intended to provide a basic knowlege and understanding of emissions control systems.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Pollution Atmosphere Hydrocarbons Oxides of Nitrogen Photochemical Smog Carbon Monoxide Positive Crankcase Ventilation Systems		

18. DISTRIBUTION STATEMENT Release Unlimited	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 100
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE PC A05 / MF A01

EPA Form 2220-1 (9-73)

☆U.S. GOVERNMENT PRINTING OFFICE: 1978-745-224

PB 279 831

EPA-450/3-77-043

November 1977

A PRIMER ON AUTO EMISSIONS SYSTEMS FOR HOME MECHANICS

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

100

EPA-450/3-77-043

A PRIMER ON AUTO EMISSIONS SYSTEMS FOR HOME MECHANICS

by

B.D. Hayes, Project Director
M.T. Maness, Associate Project Director
R.A. Ragazzi, Principal Investigator

Department of Industrial Sciences
Colorado State University
Fort Collins, Colorado 80523

EPA Grant No. T900621-01-0

EPA Project Officer: Bruce Hogarth

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Control Programs Development Division
Research Triangle Park, North Carolina 27711

November 1977

i a

Copies of this publication are available free of charge to Federal employees, current contractors and grantees, and nonprofit organizations - as supplies permit - from the Library Services Office (MD-35), Environmental Protection Agency, Research Triangle Park, North Carolina 27711; or, for a fee, from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.

This report was furnished to the Environmental Protection Agency by the Department of Industrial Sciences, Colorado State University, Fort Collins, Colorado, 80523, through Grant No. T900621-01-0. The contents of this report are reproduced herein as received from Colorado State University. The opinions, findings, and conclusions expressed are those of the authors and not necessarily those of the Environmental Protection Agency. Mention of company or product names is not to be considered as an endorsement by the Environmental Protection Agency.

Publication No. EPA-450/3-77-043

YOUR CAR
NEEDS YOU

WHY SHOULD YOU BE INTERESTED IN THIS BOOKLET ?

BECAUSE... IT HAS BEEN DESIGNED TO HELP YOU IN UNDERSTANDING THE EMISSION CONTROL SYSTEMS AND HARDWARE FOUND ON YOUR CAR.

SO WHAT?

THIS INFORMATION WILL BE BENEFICIAL IN AIDING YOU IN THE FOLLOWING WAYS:

CLEANER AIR

1. IT WILL AID YOU IN PERFORMING BASIC VISUAL CHECKS ON YOUR CAR'S EMISSION CONTROL SYSTEMS MAINTENANCE YOU PERFORM TO CORRECT PROBLEMS WILL BE BENEFICIAL IN REDUCING AIR POLLUTION, (AND LESS AIR POLLUTION IS DESIRABLE FOR EVERYONE'S HEALTH.)

2. THE BASIC MAINTENANCE AND CHECKS DESCRIBED IN THIS BOOKLET COULD AID IN SAVING YOU MONEY IN TWO WAYS:

a. YOU COULD ELECT TO CORRECT PROBLEMS YOU FIND YOURSELF.

OR

b. YOU COULD ELECT TO HAVE YOUR MECHANIC FIX THE SPECIFIC PROBLEMS YOU HAVE FOUND.

MONEY SAVED

ACKNOWLEDGEMENTS

The Motor Vehicle Emissions Control Staff at the Department of Industrial Sciences would like to acknowledge the efforts extended by the Environmental Protection Agency, Research Triangle Park, and the Motor Vehicle Manufacturers Associations for their contributions to the development of this booklet.

DISCLAIMER

The opinions, procedures and conclusions are those of the authors and not necessarily those of the Environmental Protection Agency. Every attempt has been made to represent the material in a factual, concise manner. Any mention of products or organizations does not constitute endorsement by the Environmental Protection Agency.

SAFETY NOTICE

This booklet contains numerous NOTES, CAUTIONS, and WARNINGS. It is the responsibility of the person using this booklet to carefully read these important notices to minimize the chance of personal injury and/or damage to their car.

The NOTES, CAUTIONS, and WARNINGS are NOT all inclusive.

It is the sole responsibility of any person(s) using this material to exercise their own good judgment in regard to personal and vehicle safety and consult other reference material if any doubts are present as to the safety of any act they may perform when using this booklet.

PREFACE

This booklet has been designed to acquaint the average home mechanic with the basic emissions control systems and components installed on today's cars. Emissions control equipment has been installed to reduce the amount of pollution discharged to our atmosphere. The primary reason for reducing automobile emissions is to protect your health as well as your children's and your neighbors' health.

Emissions control equipment, like any mechanical equipment, needs periodic inspection and preventive maintenance. This is where YOU the average home mechanic can play an important role in maintaining the equipment and aiding in the total effort for cleaner air.

This booklet will show you the basic emissions control systems. It will also point out other components used in conjunction with emissions control systems to lower emissions.

There are basic step by step procedures you can follow, to check out various components related to emissions control. The purpose of these checks can be considered to be two-fold.

First - the checks enable YOU to find malfunctioning parts and parts that need replacement. If you are handy with tools, you can make the necessary corrections in many cases and save yourself some money.

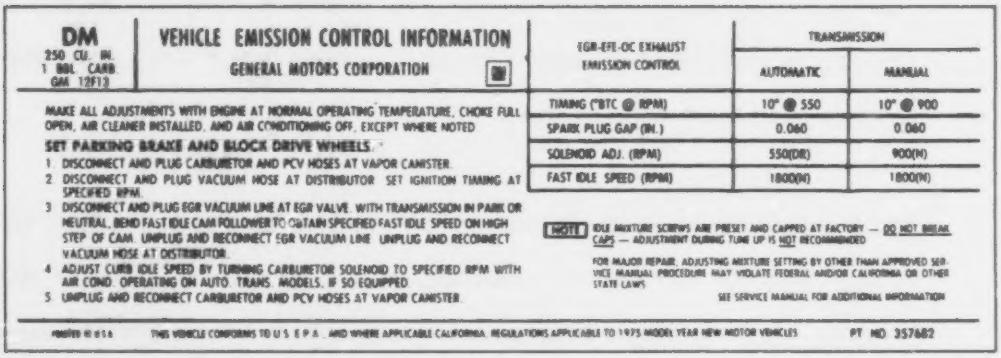
Second - if you choose to have your mechanic make the repairs, you are now in a position to explain what checks you have made and which parts you feel are in need of repair.

A little ghost called "VEC" (VEHICLE EMISSION CONTROL) will lead you through each system and the checks you can make on each system. VEC will also explain why you should not disconnect the emissions control systems or make them inoperative and how this can hurt your car's performance and gas mileage and possibly shorten the engine's life expectency. VEC will do his best to show you how keeping these systems properly maintained can aid in keeping your car running right and reduce air pollution.

THIS BOOKLET IS NOT INTENDED TO BE A SUBSTITUTE FOR, OR REPLACE A GOOD EMISSIONS CONTROL SERVICE MANUAL OR THE MANUFACTURERS SHOP SERVICE MANUAL. IT IS ONLY INTENDED TO PROVIDE A BASIC KNOWLEDGE AND UNDERSTANDING OF EMISSIONS CONTROL SYSTEMS.

This booklet does not cover basic tuneup procedures. However, performing a good basic tuneup, such as replacing worn spark plugs, points and condenser, replacing bad spark plug wires, and setting basic ignition timing is extremely important for keeping auto emissions low and fuel economy at its best. Listed in back of this booklet (Reference Material Section) are other books that can provide you with this information. We strongly suggest that you refer to these to enforce your knowledge of proper tuneup procedures.

Since 1968 nearly every car made in the United States has a VEHICLE EMISSIONS CONTROL INFORMATION label somewhere in the engine compartment. The VEHICLE EMISSIONS CONTROL INFORMATION label shown below is used by General Motors Corporation.



DM
250 CU. IN.
1 BBL. CARB.
GM 12F13

VEHICLE EMISSION CONTROL INFORMATION
GENERAL MOTORS CORPORATION

MAKE ALL ADJUSTMENTS WITH ENGINE AT NORMAL OPERATING TEMPERATURE, CHOKE FULL OPEN, AIR CLEANER INSTALLED, AND AIR CONDITIONING OFF, EXCEPT WHERE NOTED

SET PARKING BRAKE AND BLOCK DRIVE WHEELS.

1. DISCONNECT AND PLUG CARBURETOR AND PCV HOSES AT VAPOR CANISTER.
2. DISCONNECT AND PLUG VACUUM HOSE AT DISTRIBUTOR. SET IGNITION TIMING AT SPECIFIED RPM.
3. DISCONNECT AND PLUG EGR VACUUM LINE AT EGR VALVE. WITH TRANSMISSION IN PARK OR NEUTRAL, BEND FAST IDLE CAM FOLLOWER TO OBTAIN SPECIFIED FAST IDLE SPEED ON HIGH STEP OF CAM. UNPLUG AND RECONNECT EGR VACUUM LINE. UNPLUG AND RECONNECT VACUUM HOSE AT DISTRIBUTOR.
4. ADJUST CURB IDLE SPEED BY TURNING CARBURETOR SOLENOID TO SPECIFIED RPM WITH AIR COND. OPERATING ON AUTO. TRANS. MODELS, IF SO EQUIPPED.
5. UNPLUG AND RECONNECT CARBURETOR AND PCV HOSES AT VAPOR CANISTER.

EGR-EFE-OC EXHAUST EMISSION CONTROL	TRANSMISSION	
	AUTOMATIC	MANUAL
TIMING (°BTC @ RPM)	10° @ 550	10° @ 900
SPARK PLUG GAP (IN.)	0.060	0.060
SOLENOID ADJ. (RPM)	550(DR)	900(N)
FAST IDLE SPEED (RPM)	1800(N)	1800(N)

NOTE IDLE MIXTURE SCREWS ARE PRESET AND CAPPED AT FACTORY — DO NOT BREAK CAPS — ADJUSTMENT DURING TUNE UP IS NOT RECOMMENDED

FOR MAJOR REPAIR, ADJUSTING MIXTURE SETTING BY OTHER THAN APPROVED SERVICE MANUAL PROCEDURE MAY VIOLATE FEDERAL AND/OR CALIFORNIA OR OTHER STATE LAWS

SEE SERVICE MANUAL FOR ADDITIONAL INFORMATION

PRINTED IN U S A THIS VEHICLE CONFORMS TO U.S. E.P.A. AND WHERE APPLICABLE CALIFORNIA REGULATIONS APPLICABLE TO 1975 MODEL YEAR NEW MOTOR VEHICLES PT NO 357682

Chrysler Corporation, Ford Motor Company, American Motors Corporation and the imported cars use a similar label with similar procedures and settings spelled out.

REFER TO THIS LABEL WHEN TUNING UP YOUR CAR.

It can save you time, money and frustration.

CONTENTS

Introduction 1
  Hydrocarbons 3
  Oxides of Nitrogen 4
  Photochemical Smog 5
  Carbon Monoxide 5

Positive Crankcase Ventilation Systems 7
  Purpose 9
  Open PCV System 10
  Closed PCV System 12
  System Inspection and Maintenance 13
  Caution 17

Thermostatic Air Cleaner Systems 19
  Identification 21
  Purpose 22
  System Components and Function 24
  System Inspection and Maintenance 25
  Caution 31

Air Injection Reaction Systems 33
  Trade Names 35
  Purpose 35
  System Components and Function 36
  System Inspection and Maintenance 38
  Summary 43

Fuel Evaporative Control Systems 45
  Purpose 47
  System Components and Function 48
  System Inspection and Maintenance 53
  Summary 55

Exhaust Gas Recirculation Systems 57
  Purpose 59
  System Components and Function 60
  Caution - (Differences In Systems). 63
  System Inspection and Maintenance 64
    EGR Valve 64
    CTO Switch 67
    Vacuum Amplifier EGR System 69
    Exhaust Back Pressure Sensor 71
  Caution 73

Catalytic Converter 75
  Purpose 77
  Component Identification 78
  Catalytic Converter Construction and Operation 79
  Notice 81

Other Emissions Systems 83
  Spark Timing Controls 85
  OSAC Valve 87
  Vacuum Advance Shutoff 89

Dual Diaphragm Vacuum Advance Unit 90
CTO Switch 92
Summary 94

Appendix 95

Addresses For Manufacturers Service Manuals 97

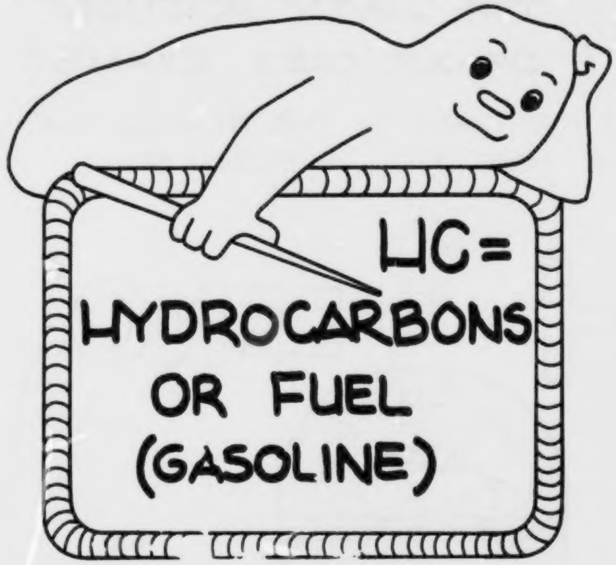
INTRODUCTION
TO EMISSIONS

VEC = VEHICLE
EMISSION CONTROL

MY NAME IS VEC AND I WOULD LIKE TO SHOW AND TELL YOU ABOUT THE EMISSION CONTROL SYSTEMS FOUND ON TODAY'S CARS.

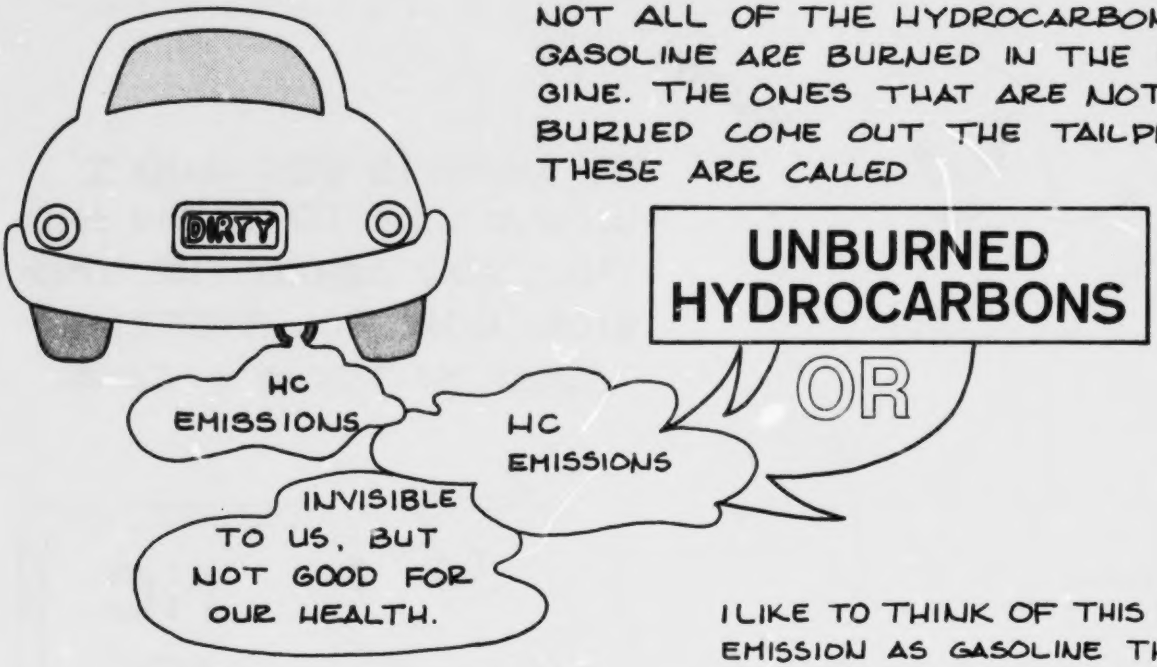
VEC
HC
NO_x
CO

BEFORE WE GET INTO SYSTEMS, I WILL TAKE A MINUTE TO EXPLAIN SOME TERMS LIKE **HC, NO_x** AND **CO.** THESE TERMS ARE FOUND IN ALL MATERIALS RELATING TO EMISSION CONTROL SYSTEMS. A BASIC KNOWLEDGE OF THESE TERMS WILL MAKE THE SYSTEMS EASIER TO UNDERSTAND.

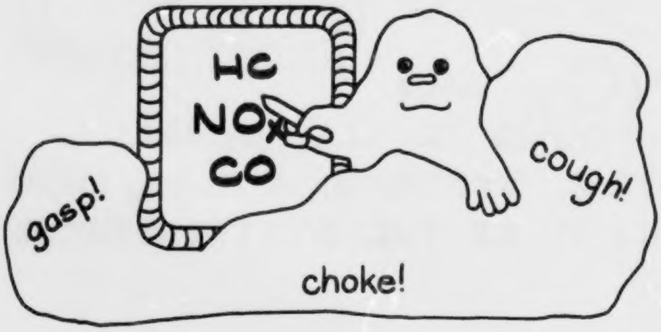


HC IS A TERM I WILL USE QUITE OFTEN. HC IS A SHORT WAY OF SAYING **HYDROCARBONS.** HYDROCARBONS ARE THE GOODIES THAT MAKE UP THE GASOLINE WE PUT IN CARS.

NOT ALL OF THE HYDROCARBONS OR GASOLINE ARE BURNED IN THE ENGINE. THE ONES THAT ARE NOT BURNED COME OUT THE TAILPIPE. THESE ARE CALLED

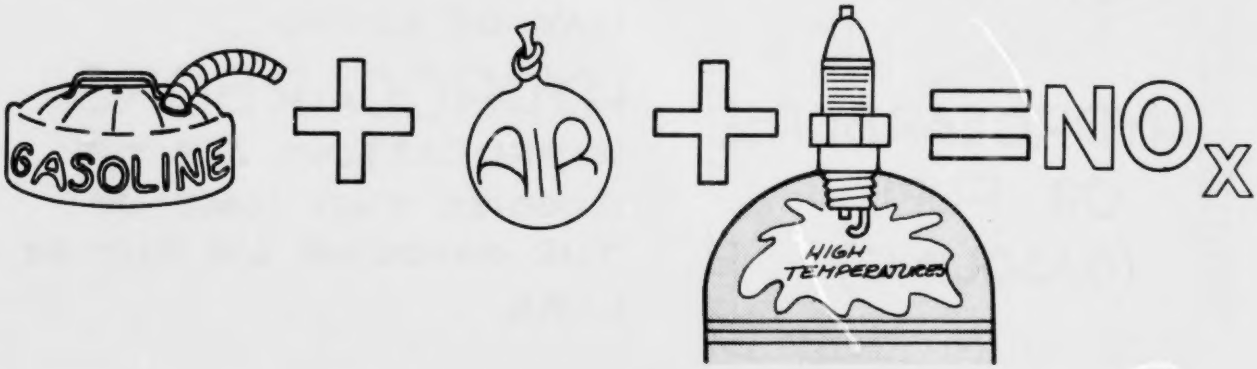

DIRTY
UNBURNED HYDROCARBONS
OR
HC EMISSIONS
HC EMISSIONS
INVISIBLE TO US, BUT NOT GOOD FOR OUR HEALTH.

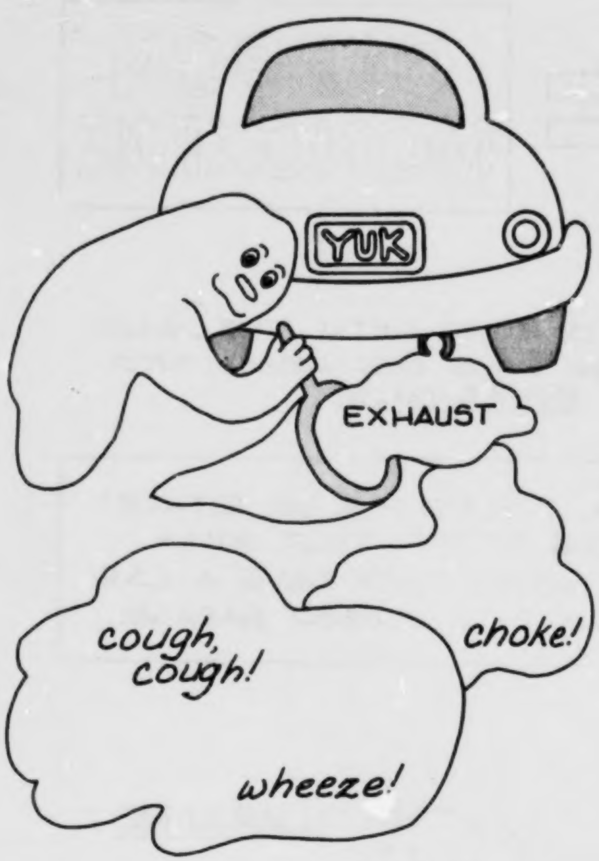
I LIKE TO THINK OF THIS DIRTY EMISSION AS GASOLINE THAT DIDN'T BURN.


HC
NO_x
CO
gasp!
cough!
choke!

NO_X IS AN ABBREVIATION FOR THE TERM OXIDES OF NITROGEN. NO_x IS THE WORD I WILL USE TO IDENTIFY THIS NASTY PORTION OF OUR CARS' EXHAUST.

NO_x IS FORMED WHEN GASOLINE AND AIR BURN IN THE ENGINE. THE HOTTER THE AIR AND FUEL BURN, THE MORE NO_x IS PRODUCED.


GASOLINE
+
AIR
+
HIGH TEMPERATURES
=
NO_X


YUK
EXHAUST
cough, cough!
choke!
wheeze!

HC AND NO_x EMISSIONS FROM THE AUTOMOBILE MUST BE **CONTROLLED** BECAUSE THEY ARE CONSIDERED A

TO OUR HEALTH AND THE ENVIRONMENT.

R.I.P.*
BLUE SKY

*REST IN POLLUTION

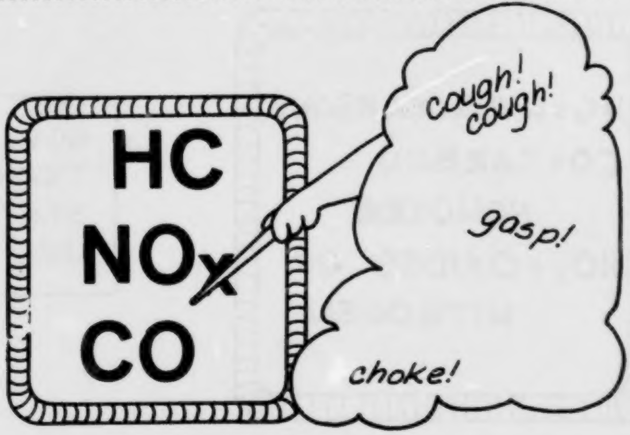
HC + NO_x + SUN = PHOTOCHEMICAL SMOG

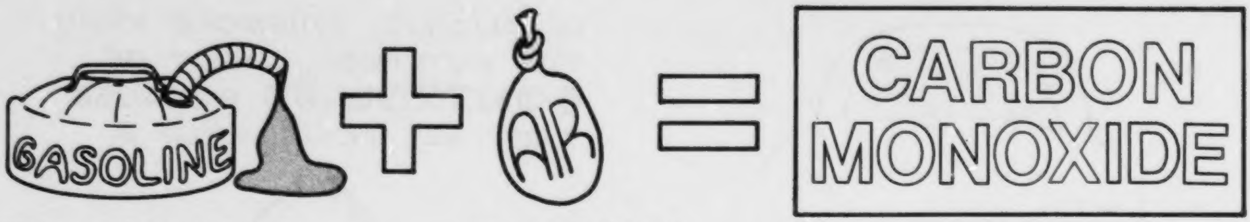
(UNBURNED GASOLINE)

HC AND NO_x FORM PHOTOCHEMICAL SMOG IN THE PRESENCE OF SUNLIGHT. THIS PHOTOCHEMICAL SMOG HAS A LOT OF NASTY STUFF IN IT THAT MAKES OUR EYES WATER AND MAKES BREATHING HARD FOR PEOPLE WITH RESPIRATORY DISEASES. IT ALSO ROTS RUBBER AND DAMAGES PLANTS.

☆☆

ANOTHER TERM WE USE IS CO. CO IS A SHORTER WAY OF SAYING CARBON MONOXIDE.


HC
NOx
CO
cough! cough!
gasp!
choke!

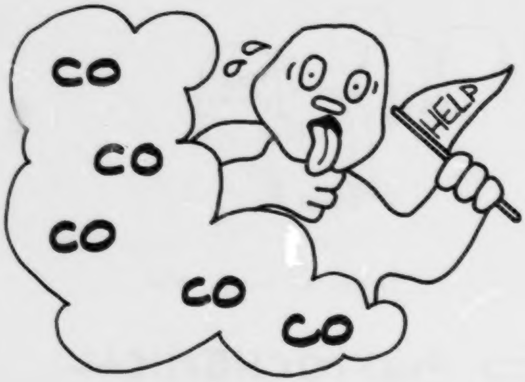

GASOLINE
+
AIR
=
CARBON MONOXIDE

TOO MUCH FUEL

NOT ENOUGH AIR

CO RESULTS WHEN NOT ENOUGH AIR IS MIXED WITH THE GASOLINE WE BURN IN OUR ENGINES. THIS CO IS DISCHARGED INTO THE ATMOSPHERE AND IS CALLED **CO EMISSIONS.**

CO ISN'T GOOD FOR US, EITHER! CO IS THE STUFF THAT KILLS PEOPLE WHEN THEY HAVE A CAR RUNNING IN A CLOSED GARAGE.


CO
CO
CO
CO
CO
HELP

CO, IN SMALLER AMOUNTS, WILL GIVE YOU A HEADACHE, OR COULD MAKE YOU SICK TO YOUR STOMACH. BARF!

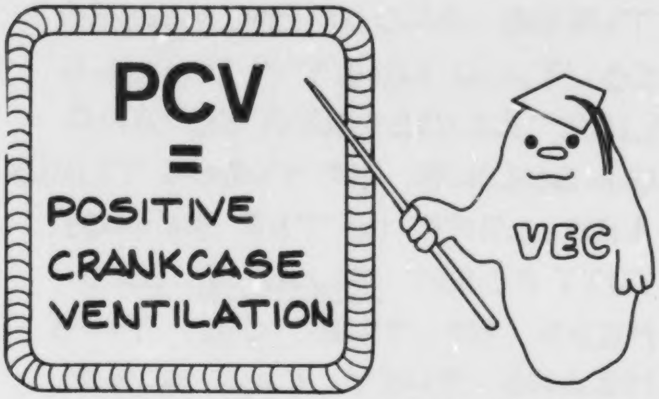
WARNING:

KEEP WORK AREAS WELL VENTILATED

HC = HYDROCARBONS
CO = CARBON MONOXIDE
NO_x = OXIDES OF NITROGEN

NOW THAT YOU UNDERSTAND THE TERMS I WILL BE USING, I CAN GET STARTED ON SPECIFIC SYSTEMS USED TO CONTROL HC, NO_x AND CO.

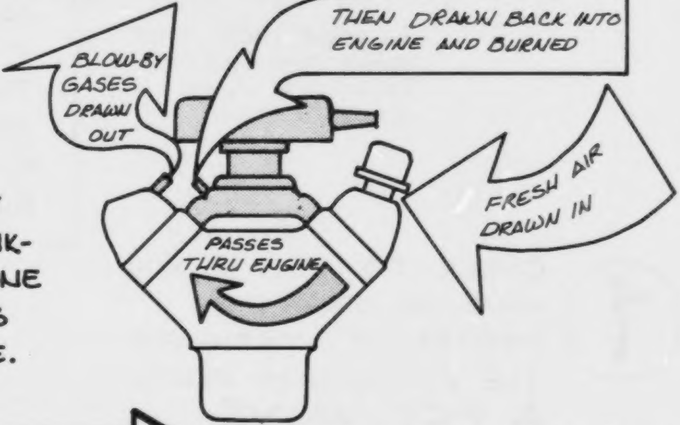
POSITIVE CRANKCASE VENTILATION SYSTEMS


PCV
=
POSITIVE
CRANKCASE
VENTILATION
VEC

THE FIRST SYSTEM I WILL SHOW YOU IS THE P.C.V. SYSTEM. THE LETTERS P.C.V. STAND FOR **POSITIVE CRANKCASE VENTILATION.**

DAILY NEWS
PCV INTRODUCED ON AMERICAN CARS IN THE MID-1960'S.

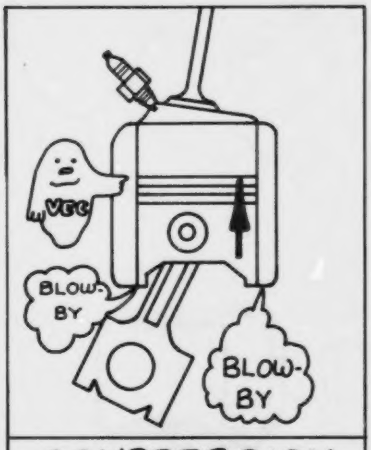
P.C.V. SYSTEMS HAVE BEEN USED ON AMERICAN CARS SINCE THE 1960'S. IT IS ONE OF THE OLDEST SYSTEMS AND ONE OF THE MOST NEGLECTED! (THE U.S. ARMY USED THIS SYSTEM BACK IN THE 1940'S.)


BLOW-BY GASES DRAWN OUT
THEN DRAWN BACK INTO ENGINE AND BURNED
FRESH AIR DRAWN IN
PASSES THRU ENGINE

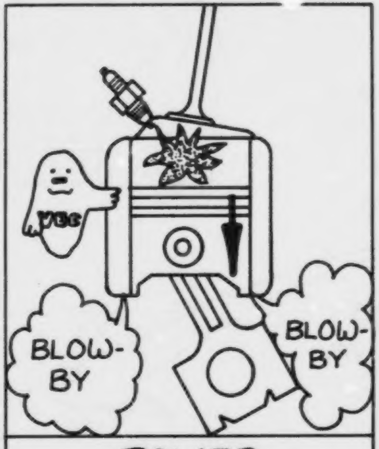
THIS SYSTEM DRAWS BLOW-BY GASES OUT OF THE ENGINE CRANKCASE, AND BACK INTO THE ENGINE TO BE BURNED. IT ALSO DRAWS FRESH AIR INTO THE CRANKCASE. THIS IS WHAT WE MEAN BY

CRANKCASE VENTILATION

VENTLATION, OR CHANGING THE AIR, OCCURS WHENEVER THE ENGINE IS RUNNING.


VEC
BLOW-BY
BLOW-BY

COMPRESSION STROKE


VEC
BLOW-BY
BLOW-BY

POWER STROKE

BLOW-BY IS MADE UP OF GASES THAT SNEAK PAST THE PISTON RINGS AS THE PISTON SQUEEZES EVERYTHING INTO A SMALL SPACE. EVEN MORE BLOW-BY OCCURS WHEN THE SPARK PLUG FIRES AND THE AIR-FUEL MIXTURE BEGINS TO BURN IN THE COMBUSTION CHAMBER.

Preceding page blank

THESE BLOW-BY GASES CONTAIN NASTY THINGS LIKE ACIDS, WATER AND GASOLINE. IF THESE THINGS ARE LEFT IN THE ENGINE, THEY FORM SLUDGE AND MESS UP THE OIL. THIS MEANS THEY CAN ALSO MESS UP YOUR ENGINE.

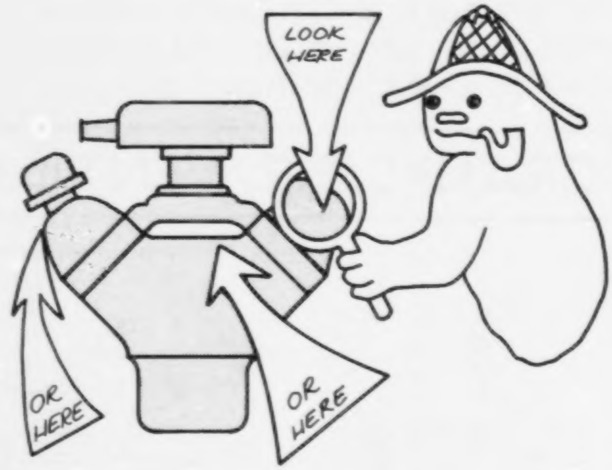
SLUDGE LIKE THIS SHORTENS YOUR ENGINE'S LIFE EXPECTANCY

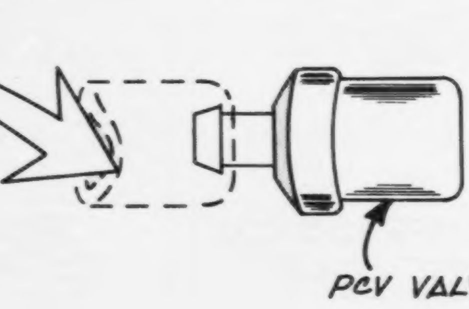
> IF YOUR CAR WAS MADE IN THE EARLY, OR MID 1960'S, IT PROBABLY HAS WHAT IS KNOWN AS THE **OPEN PCV SYSTEM**. THE OPEN SYSTEM RECYCLES MOST OF THE BLOW-BY GASES BACK TO THE ENGINE TO BE BURNED.

① CHECK TO SEE IF YOU HAVE AN OPEN PCV SYSTEM BY LOOKING FOR THE FOLLOWING PARTS:

A PCV VALVE.

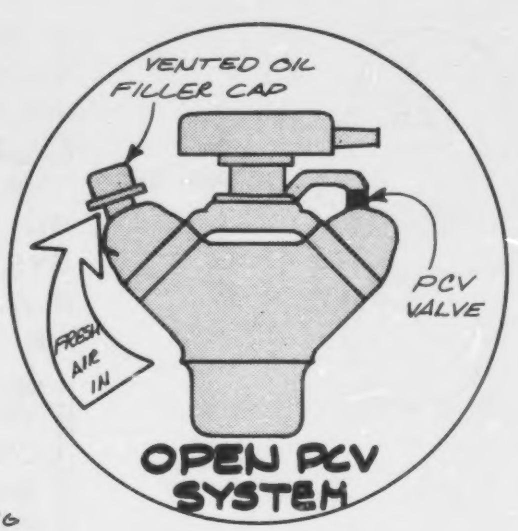
THIS CAN BE FOUND PLUGGED INTO THE LEFT OR RIGHT VALVE COVER, OR HIDDEN BEHIND OR UNDER THE INTAKE MANIFOLD. IT IS A SMALL ROUND METAL OBJECT AND WILL BE AT ONE END OF A RUBBER HOSE ABOUT THIS BIG. A GOOD SERVICE MANUAL WILL HELP YOU LOCATE THE PCV VALVE.

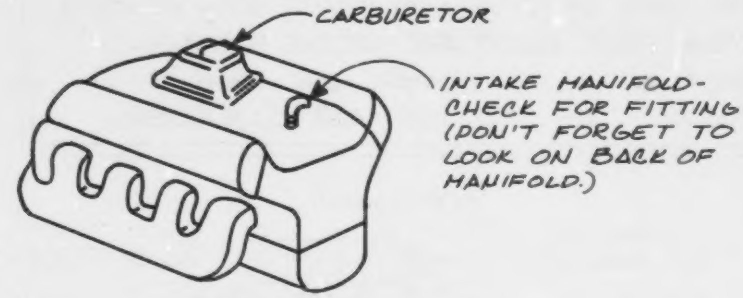




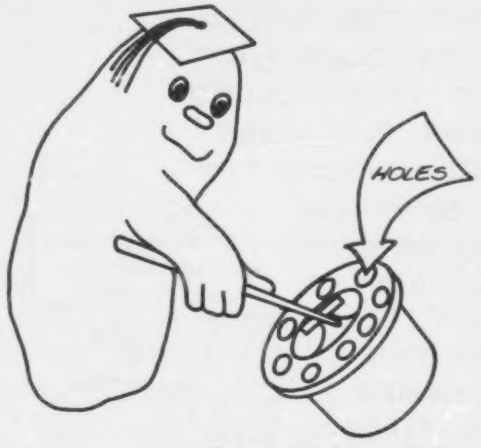
PCV VALVE

THE OTHER END OF THE HOSE WILL BE ATTACHED TO THE INTAKE MANIFOLD, (THE BIG METAL PART THE CARBURETOR SITS ON.) LOOK FOR THAT CONNECTION AROUND THE BOTTOM OF THE CARBURETOR. IT MAY ALSO BE ATTACHED TO A FITTING SCREWED INTO THE INTAKE MANIFOLD.

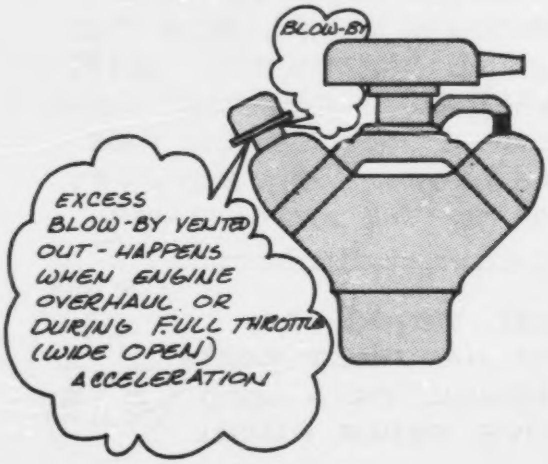

VENTED OIL FILLER CAP
PCV VALVE
FRESH AIR IN
OPEN PCV SYSTEM


CARBURETOR
INTAKE MANIFOLD- CHECK FOR FITTING (DON'T FORGET TO LOOK ON BACK OF MANIFOLD.)

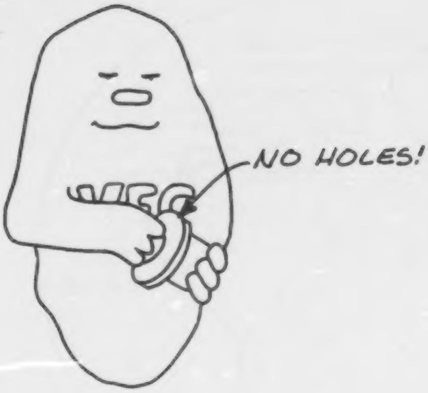
② ANOTHER ITEM TO CHECK IS THE CAP WHERE YOU PUT IN THE OIL. TURN THIS OVER AND LOOK AT IT. IF IT HAS A LOT OF HOLES IN IT, WITH STUFF BEHIND THE HOLES THAT LOOKS SOMEWHAT LIKE A SCOURING PAD, YOU HAVE AN **OPEN PCV SYSTEM.**



OIL FILLER CAP

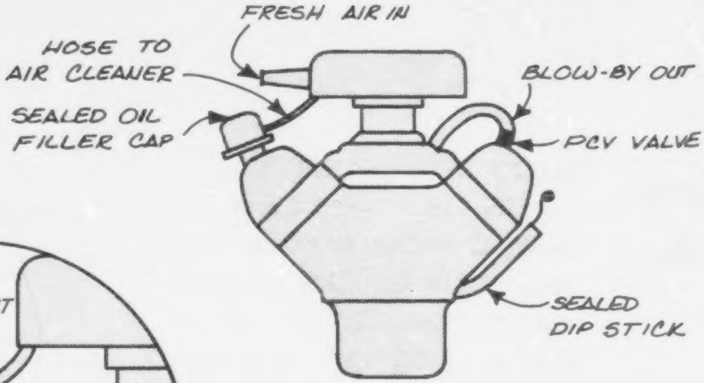

BLOW-BY
EXCESS BLOW-BY VENTED OUT - HAPPENS WHEN ENGINE OVERHAUL OR DURING FULL THROTTLE (WIDE OPEN) ACCELERATION

THE OPEN PCV SYSTEM HAS ONE DISADVANTAGE: WHEN THERE IS TOO MUCH BLOW-BY, THE PCV VALVE CANNOT HANDLE ALL OF IT. THE EXTRA BLOW-BY IS SIMPLY PUSHED OUT OF THESE HOLES IN THE OIL FILLER CAP. THIS LETS THAT UNBURNED HC GET OUT AND MESS UP OUR AIR. (GETS THE VALVE COVERS OILY, TOO.)

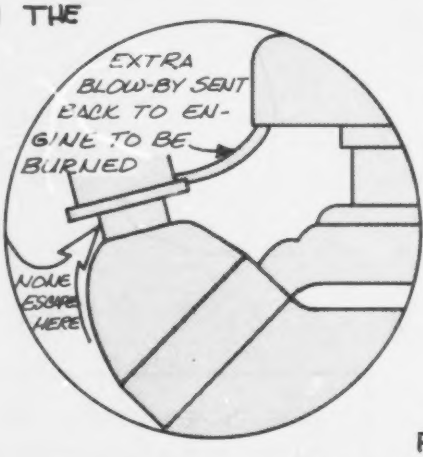


IF YOU FOUND THE HOSE WITH THE PCV VALVE, BUT THE OIL FILLER CAP HAS NO HOLES IN IT, YOU PROBABLY HAVE A **CLOSED PCV SYSTEM.** THE CLOSED PCV SYSTEM IS FOUND ON MOST CARS TODAY. THE CLOSED SYSTEM PREVENTS THAT "EXTRA" BLOW-BY FROM GETTING OUT INTO THE AIR.

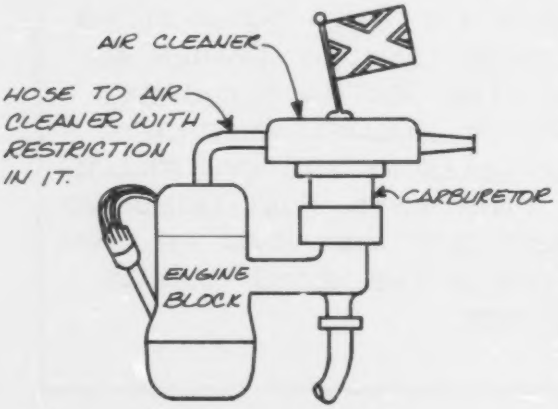
> TO SEE IF IT IS A CLOSED PCV SYSTEM, LOOK FOR ANOTHER HOSE RUNNING FROM A VALVE COVER OR THE OIL FILLER CAP TO THE AIR CLEANER.


FRESH AIR IN
HOSE TO AIR CLEANER
SEALED OIL FILLER CAP
BLOW-BY OUT
PCV VALVE
SEALED DIP STICK

WITH THE CLOSED PCV SYSTEM THE EXTRA BLOW-BY DOES NOT ESCAPE. IT IS PULLED THROUGH THE HOSE THAT RUNS FROM THE VALVE COVER OR OIL FILLER CAP TO THE AIR CLEANER. IT ENTERS THE AIR CLEANER AND IS PULLED BACK INTO THE ENGINE TO BE BURNED.


EXTRA BLOW-BY SENT BACK TO ENGINE TO BE BURNED
NONE ESCAPE HERE

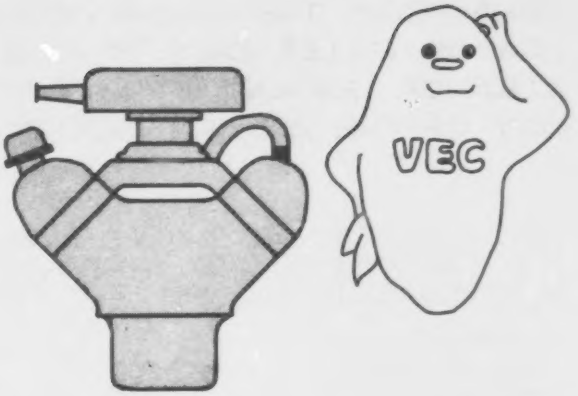
SOME FOREIGN CARS DO DO NOT HAVE A PCV VALUE VALVE. IF YOU OWN ONE AND CAN FIND ONLY ONE HOSE, THAT HOSE WILL PROBABLY RUN FROM THE VALVE COVER TO THE **AIR CLEANER.** INSIDE THAT HOSE WILL BE A SMALL RESTRICTION THAT LIMITS THE AMOUNT OF BLOW-BY THAT GETS TO THE AIR CLEANER.


AIR CLEANER
HOSE TO AIR CLEANER WITH RESTRICTION IN IT.
CARBURETOR
ENGINE BLOCK

IF IN DOUBT, DO AS I DO; CHECK THE MANUFACTURER'S SERVICE MANUAL OR A GOOD AUTOMOTIVE REPAIR MANUAL.

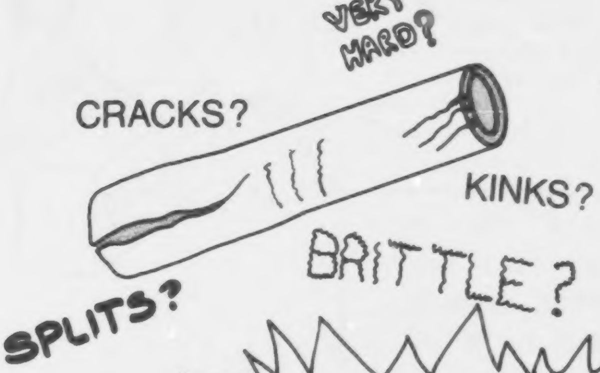
NOW, LET'S SEE HOW YOU CAN CHECK THESE SYSTEMS. I'LL SHOW YOU HOW TO CHECK THE OPEN PCV SYSTEM FIRST. (MANY OF THESE CHECKS ARE GOOD FOR THE CLOSED PCV SYSTEM, TOO.

FIRST OFF, LET'S LOOK CLOSELY AT THE FOLLOWING ITEMS



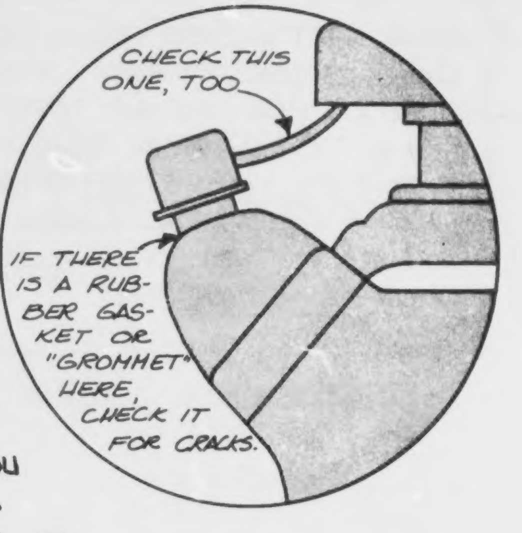
ITEM 1.

CHECK THE HOSE THAT THE PCV VALVE IS PLUGGED INTO. IS IT VERY HARD AND BRITTLE? IS IT CRACKED WHERE IT BENDS? DOES IT FIT OVER THE MANIFOLD LIKE SOCKS ON A ROOSTER? NO LOOSE OR SLOPPY FITS ALLOWED! NO KINKS EITHER.


VERY HARD?
CRACKS?
KINKS?
BRITTLE?
SPLITS?

IF THE HOSE FITS ANY OF THE ABOVE DESCRIPTIONS, REPLACE IT WITH A PIECE OF HOSE MADE FOR PCV SYSTEMS. DON'T TRY TO USE A PIECE OF HEATER HOSE OR OLD GARDEN HOSE. THE STUFF FROM THE ENGINE WILL EAT UP HOSE THAT IS NOT DESIGNED FOR PCV SYSTEMS. THE WRONG HOSE MAY ALSO COLLAPSE FROM THE ENGINE VACUUM.

IF YOUR CAR HAS THE CLOSED SYSTEM, CHECK THE HOSE THAT RUNS FROM THE VALVE COVER (OR OIL FILLER CAP) TO THE AIR CLEANER. REPLACE IT IF IT FITS ANY OF THE ABOVE DESCRIPTIONS.

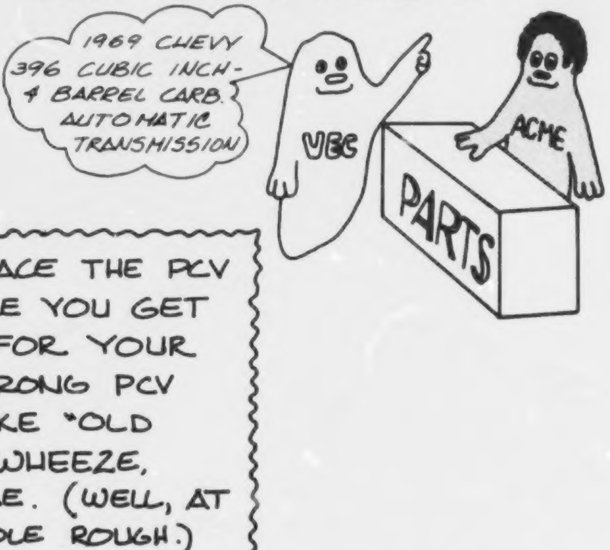

CHECK THIS ONE, TOO
IF THERE IS A RUBBER GASKET OR "GROMMET" HERE, CHECK IT FOR CRACKS.

ITEM 2.

REMOVE THE PCV VALVE. HOLD IT IN YOUR HAND AND SHAKE IT. CAN YOU HEAR SOMETHING RATTLING INSIDE? IF YOU CAN'T HEAR A RATTLE, BETTER GO BUY A NEW PCV VALVE. EVEN IF IT DOES RATTLE, YOU SHOULD REPLACE IT IF IT HAS SEEN OVER 12,000 MILES OF SERVICE. A PCV VALVE THAT IS NOT OPERATING CORRECTLY CAN CAUSE ENGINE PROBLEMS.

NO RATTLE! REPLACE IT! AND EVEN IF IT DOES RATTLE, THAT DOESN'T MEAN IT'S GOOD
VEC

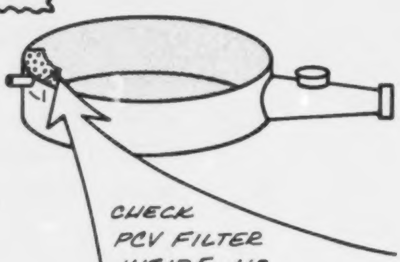
CHECK THE GROMMET THAT THE PCV VALVE GOES INTO ON THE VALVE COVER


1969 CHEVY 396 CUBIC INCH - 4 BARREL CARB. AUTOMATIC TRANSMISSION
VEC
ACME
PARTS

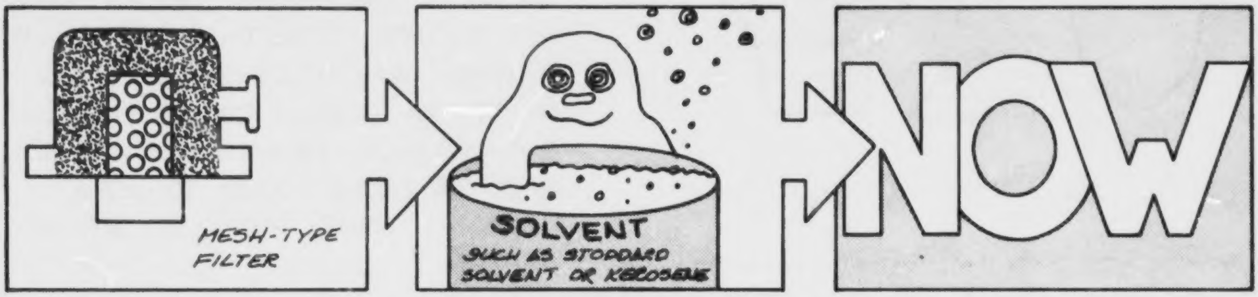
CAUTION: INSURE PCV VALVE IS INSTALLED PROPERLY

IF YOU DO REPLACE THE PCV VALVE, MAKE SURE YOU GET THE RIGHT ONE FOR YOUR ENGINE. THE WRONG PCV VALVE COULD MAKE "OLD JESSIE" COUGH, WHEEZE, BUCK, AND SHAKE. (WELL, AT LEAST MAKE IT IDLE ROUGH.)

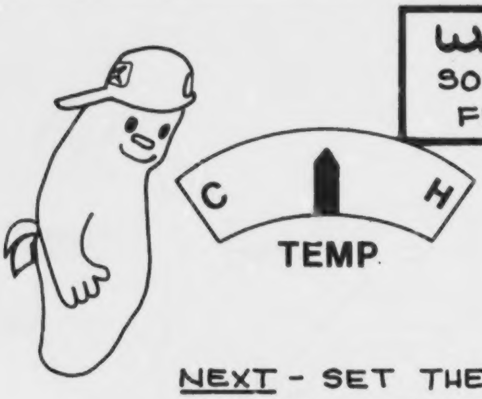
MOST CLOSED PCV SYSTEMS WILL HAVE A FILTER ON THE LINE THAT RUNS FROM THE VALVE COVER TO THE AIR CLEANER. IF THAT LINE COMES FROM THE OIL FILLER CAP, THERE IS PROBABLY A MESH-TYPE FILTER INSIDE THE OIL FILLER CAP.


CHECK PCV FILTER INSIDE AIR CLEANER. (IT'S USUALLY FILTHY.)

THE FILTER INSIDE THE AIR CLEANER IS INEXPENSIVE AND SHOULD BE REPLACED EVERY 6-12,000 MILES. (SEE WHAT THE GUYS THAT MADE YOUR CAR SUGGEST IN THE OPERATOR'S MANUAL.) THE FILTER IN THE OIL FILLER CAP SHOULD BE CLEANED IN A SUITABLE SOLVENT AND EITHER BLOWN DRY, OR LET IT "DRIP DRY" IF YOU DON'T HAVE ANY COMPRESSED AIR. THIS IS FOR BOTH "OPEN" AND "CLOSED" PCV SYSTEMS.


MESH-TYPE FILTER
SOLVENT
SUCH AS STODDARD SOLVENT OR KEROSENE
NOW

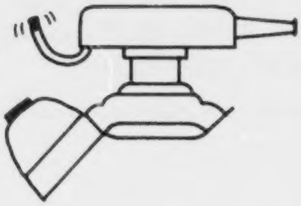
WARNING!
SOLVENTS ARE FLAMMABLE



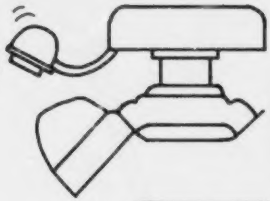
LET'S CHECK OUT THAT PCV SYSTEM AND SEE IF IT'S "VENTILATING" THE CRANKCASE. **WARNING** - FIRST OF ALL - MAKE SURE THE AREA YOU ARE WORKING IN IS WELL VENTILATED.

NEXT - SET THE PARKING BRAKE AND THEN START THE ENGINE. LET THE ENGINE WARM UP TO NORMAL OPERATING TEMPERATURE.

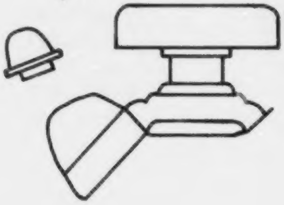
A ~ IF YOU HAVE A CLOSED PCV SYSTEM:
REMOVE THE LINE THAT RUNS FROM THE VALVE COVER TO THE AIR CLEANER.



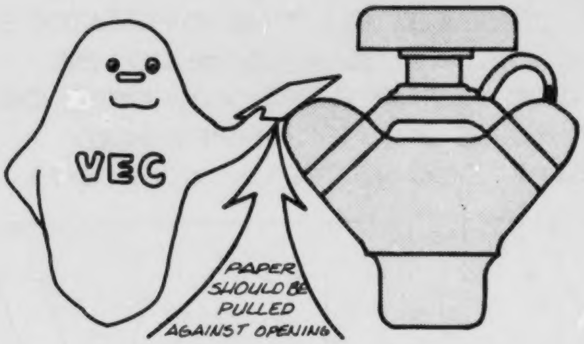
B ~ IF YOU HAVE THE OIL FILLER CAP TYPE:
REMOVE THE OIL FILLER CAP



C ~ IF IT'S AN OPEN PCV SYSTEM:
REMOVE THE OIL FILLER CAP.

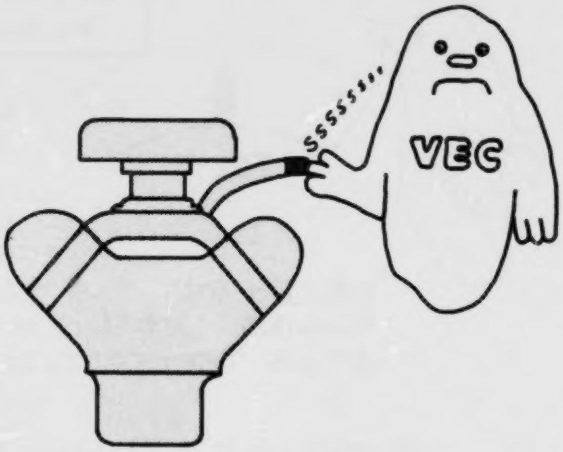


THAT WASN'T HARD WAS IT?

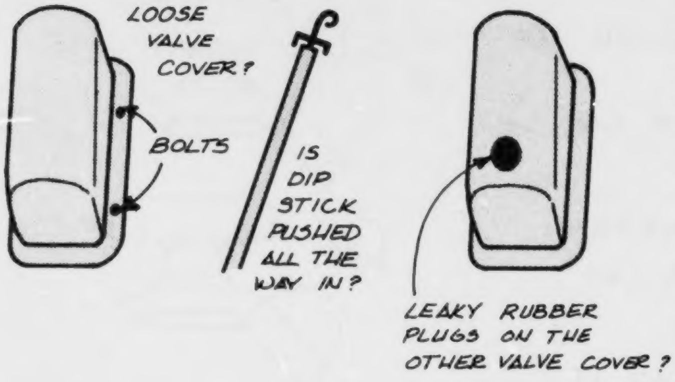

VEC
PAPER SHOULD BE PULLED AGAINST OPENING

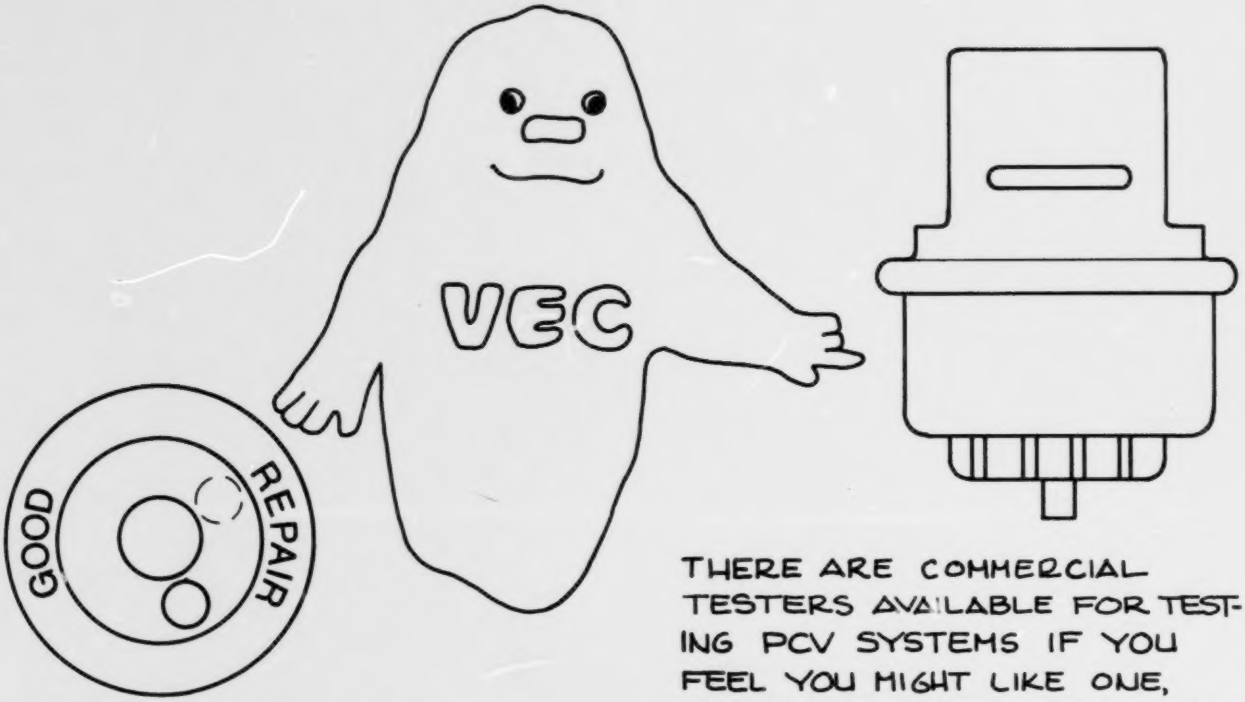
WITH THE ENGINE STILL IDLING, PLACE A PIECE OF FAIRLY STIFF PAPER, LIKE A POST CARD, OVER THE OPENING IN THE VALVE COVER. AFTER A SHORT PERIOD OF TIME THAT PIECE OF PAPER SHOULD BE HELD DOWN FAIRLY TIGHT. (THAT IS, IF EVERYTHING IS WORKING RIGHT.) IF IT IS HELD DOWN, PLUG EVERYTHING BACK INTO IT'S PROPER PLACE AND TAKE A BREAK. YOUR PCV SYSTEM IS O.K.

IF THE PAPER IS NOT BEING HELD DOWN, PULL THE PCV VALVE OUT. YOU SHOULD HEAR A HISSING SOUND AND FEEL A STRONG SUCTION WHEN YOU PUT YOUR FINGER OVER THE VALVE. IF NOT, PULL THE VALVE OUT OF THE HOSE AND SEE IF YOU FEEL A STRONG SUCTION AT THE END OF THE HOSE. IF NOT, SOMETHING IS PLUGGED - EITHER THE HOSE OR THE MANIFOLD CONNECTION. FIND OUT WHERE AND CLEAN 'ER OUT!



IF THE PCV VALVE CHECKS OUT O.K., AND THE PAPER IS STILL NOT HELD DOWN TO THE VALVE COVER, START LOOKING FOR LEAKY GASKETS, LOOSE VALVE COVER BOLTS, OR A LOOSE OIL DIP STICK. THERE IS A LEAK SOMEWHERE THAT IS LETTING AIR INTO THE CRANKCASE. THE ONLY PLACE AIR SHOULD ENTER THE CRANKCASE IS THROUGH THE HOLE YOU HAVE THE PAPER OVER.


LOOSE VALVE COVER?
BOLTS
IS DIP STICK PUSHED ALL THE WAY IN?
LEAKY RUBBER PLUGS ON THE OTHER VALVE COVER?



THERE ARE COMMERCIAL TESTERS AVAILABLE FOR TESTING PCV SYSTEMS IF YOU FEEL YOU MIGHT LIKE ONE, CHECK WITH YOUR LOCAL PARTS STORE. HE WILL BE ABLE TO GET YOU ONE.

ONE WORD OF CAUTION:

NEVER EVER PLUG THE PCV SYSTEM. THIS WILL CAUSE A BUILDUP OF PRESSURE IN THE CRANKCASE. THIS PRESSURE FORCES OIL AND BLOWBY GASES OUT OF GASKETED AREAS AND OIL SEALS AND MAKES A TERRIBLE MESS. ALSO, THE ACIDS AND SLUDGE THAT WILL RESULT WILL SHORTEN YOUR ENGINE'S LIFE.

SERVICE INTERVALS DO VARY. CHECK THE MANUFACTURER'S SERVICE MANUAL.

THERMOSTATIC

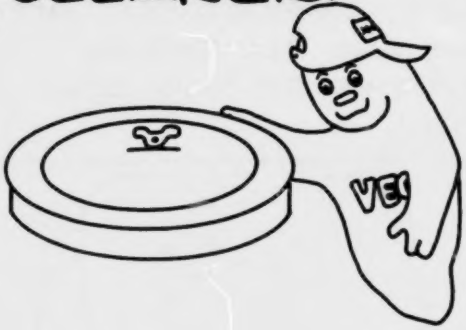
AIR CLEANER SYSTEMS

Preceding page blank

THERMOSTATIC AIR CLEANERS

LETS LOOK AT ANOTHER SYSTEM THAT CAME OUT TOWARDS THE END OF THE 60s. THIS ONE IS ABBREVIATED T.A.C. T.A.C. STANDS FOR **THERMOSTATIC AIR CLEANER.**

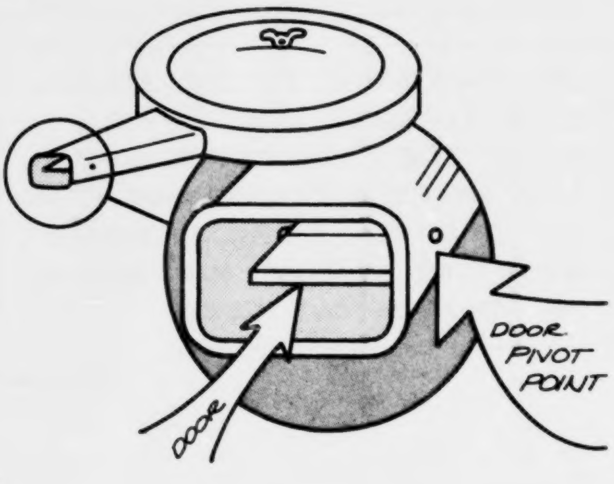
VEC
TAC
=
THERMOSTATIC
AIR
CLEANER



IF YOUR CAR IS A 1967 OR NEWER MODEL, TAKE A WALK OUT AND OPEN THE HOOD. FIND THE AIR CLEANER ASSEMBLY. IT IS USUALLY ROUND, BLACK OR BLUE, AND SITS DIRECTLY OVER THE CARBURETOR. IT WILL PROBABLY BE HELD IN PLACE BY ONE OR TWO WING NUTS.

NEXT

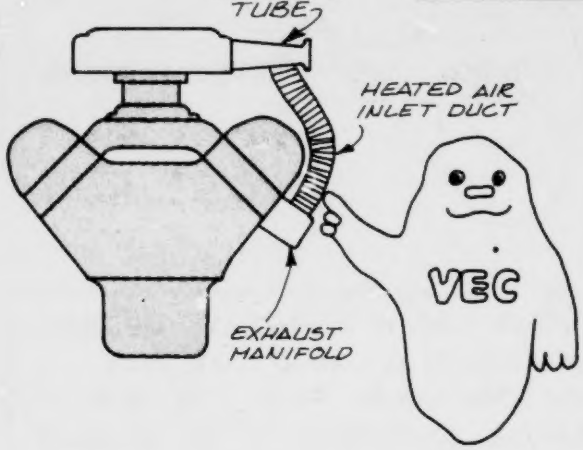
CHECK AND SEE IF THAT AIR CLEANER HAS A "SNOUT" OR "SNORKEL" TUBE" ON IT. IF IT DOES, TAKE A LOOK INSIDE THAT TUBE. IF YOU CAN SEE A DOOR IN THERE, YOU HAVE A THERMOSTATIC - TYPE AIR CLEANER. THIS SYSTEM IS OFTEN CALLED A **HEATED AIR INDUCTION SYSTEM.** DON'T BE CONFUSED. THIS IS JUST ANOTHER WAY OF SAYING THE SAME THING.



Preceding page blank

STILL NOT SURE, HUH?

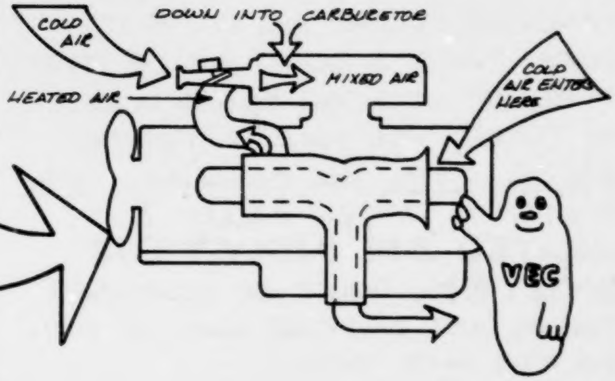
TO CHECK A LITTLE FURTHER, SEE IF THERE IS A METAL OR FLEXIBLE TUBE RUNNING FROM THE BOTTOM OF THE SNORKEL TUBE DOWN TO THE EXHAUST MANIFOLD. THIS PART IS THE HEATED AIR INLET DUCT.

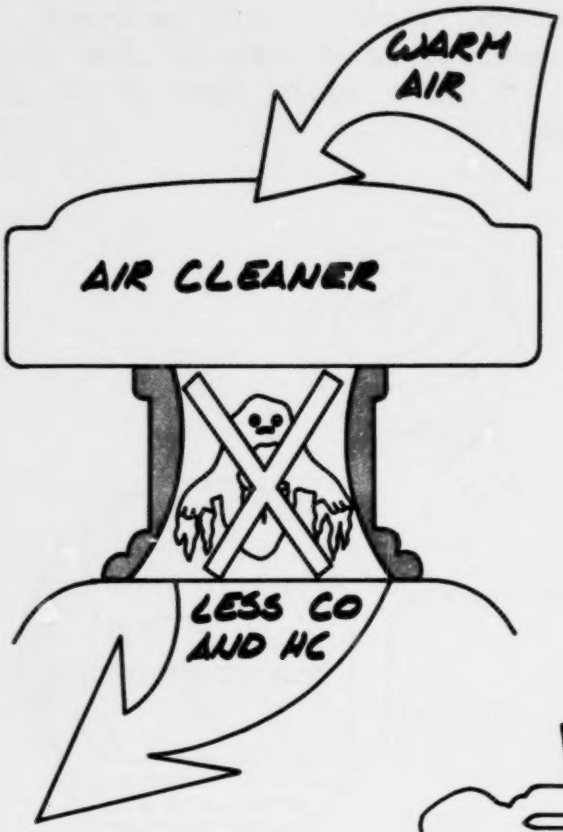

SNORKEL TUBE
HEATED AIR INLET DUCT
EXHAUST MANIFOLD
VEC

YOU SAY YOU HAVE ONE? BUT NOW I'LL BET YOU ARE WONDERING WHY THAT GADGET WAS PUT ON YOUR CAR. MAKE YOURSELF COMFORTABLE AND READ ON, AND I'LL EXPLAIN THE PURPOSE OF THIS CONTRAPTION.

THE PURPOSE

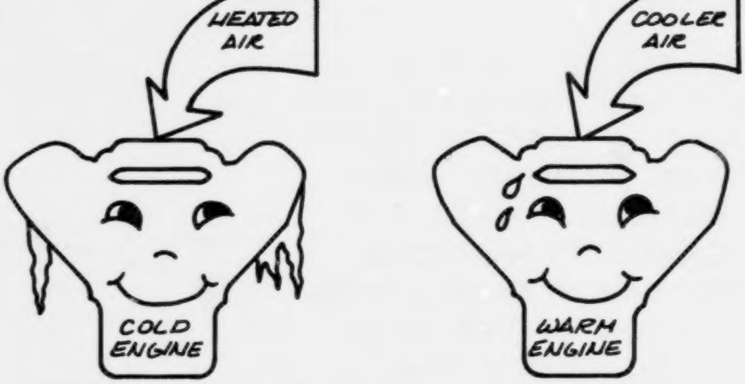
OF THIS AIR CLEANER ASSEMBLY IS TO HAVE HEATED AIR ENTER THE CARBURETOR WHEN YOU START A COLD ENGINE. THE AIR IS HEATED BY BEING DRAWN OVER THE EXHAUST MANIFOLD AS I'M POINTING OUT HERE.


COLD AIR
DOWN INTO CARBURETOR
MIXED AIR
HEATED AIR
COLD AIR ENTERS HERE
VEC


WARM AIR
AIR CLEANER
LESS CO AND HC

THE WARM AIR BEING DRAWN INTO THE CARBURETOR HELPS TO REDUCE **HC** AND **CO** EMISSIONS WHILE YOUR ENGINE IS WARMING UP. **CARBURETOR ICING,** WHICH CAN BE A FRUSTRATING EXPERIENCE, IS VIRTUALLY ELIMINATED BY THIS WARM AIR ALSO

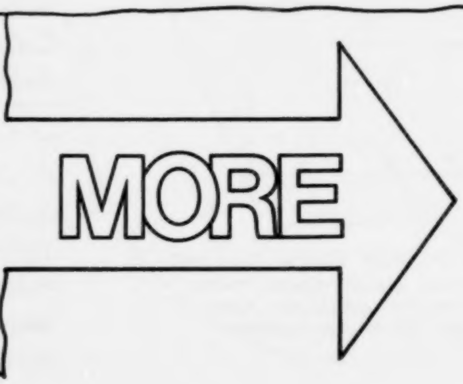
ANOTHER ADVANTAGE TO A THERMOSTATIC AIR CLEANER IS THAT IT MAKES "OLD JESSIE" A LOT EASIER TO DRIVE WHEN THE WEATHER TURNS COLD.


HEATED AIR
COOLER AIR
COLD ENGINE
WARM ENGINE

HEATED AIR REALLY HELPS COLD ENGINES TO RUN BETTER. BUT! – AS THE ENGINE WARMS UP IT NEEDS COOLER AIR. THIS COOLER AIR HELPS IN GIVING US MORE MILES PER GALLON AND A LITTLE MORE ZIP.

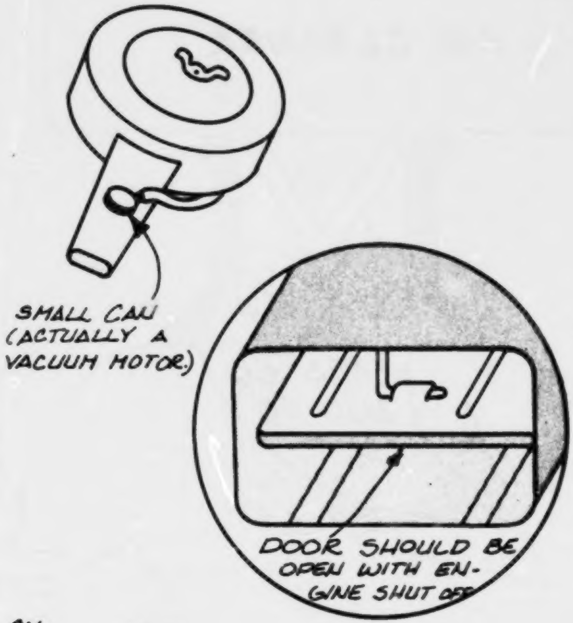
NOW

I WOULD LIKE TO SHOW YOU HOW WE CHANGE FROM HEATED AIR TO COOLER AIR. AT THE SAME TIME YOU CAN CHECK TO SEE IF YOUR HEATED AIR SYSTEM IS WORKING O.K.

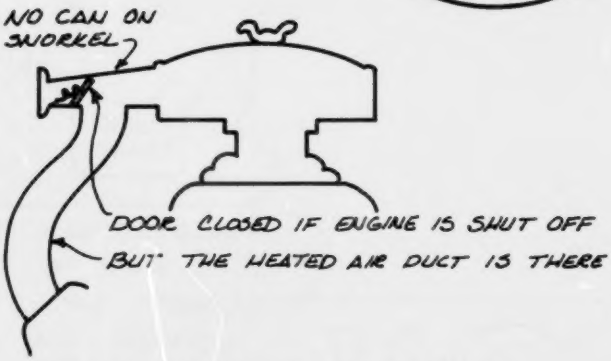


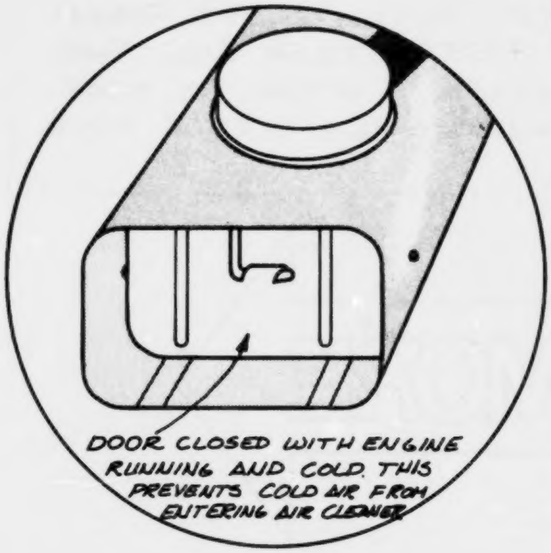
SINCE THE NAME OF THE GAME IS "HOT AIR WHEN COLD, AND COLD AIR WHEN HOT," THE EASIEST WAY TO DO THIS IS WITH A DOOR. BY MOVING THIS DOOR UP OR DOWN WE CAN HAVE HEATED AIR OR COOLER AIR. RIGHT? LET'S CHECK IT OUT AND SEE IF IT IS OPERATING THE WAY IT IS SUPPOSED TO.

O.K. BACK UNDER THE HOOD! TAKE A LOOK AT THE SNORKEL TUBE. DOES IT HAVE A SMALL ROUND CAN ON IT WITH A HOSE ATTACHED TO IT? IF IT DOES, LOOK INSIDE THE SNORKEL WITH THE ENGINE SHUT OFF. THE DOOR SHOULD BE OPEN LIKE I'M SHOWING YOU HERE.


SMALL CAN (ACTUALLY A VACUUM MOTOR.)
DOOR SHOULD BE OPEN WITH ENGINE SHUT OFF

IF... THERE ISN'T A SMALL ROUND CAN ON IT, BUT YOU HAVE A TUBE OR FLEXIBLE PIPE RUNNING FROM THE SNORKEL DOWN TO THE EXHAUST MANIFOLD, YOU PROBABLY OWN A FORD, RIGHT? LOOK IN THE END OF THE SNORKEL – THE DOOR SHOULD BE CLOSED.


NO CAN ON SNORKEL
DOOR CLOSED IF ENGINE IS SHUT OFF
BUT THE HEATED AIR DUCT IS THERE

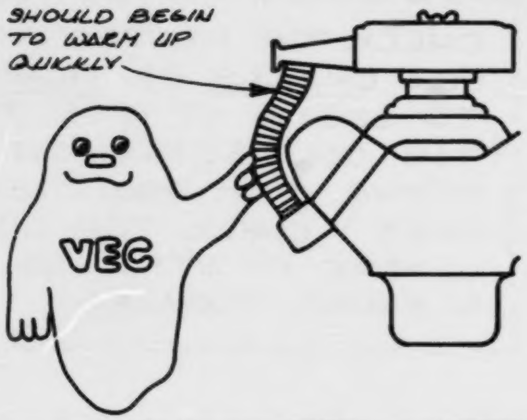

DOOR CLOSED WITH ENGINE RUNNING AND COLD. THIS PREVENTS COLD AIR FROM ENTERING AIR CLEANER

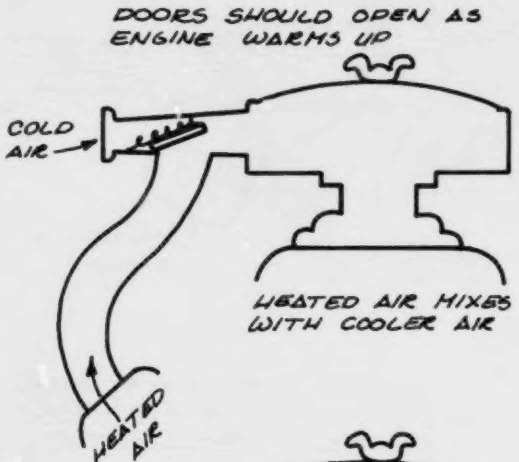
NOW START YOUR ENGINE.

WARNING. FIRST, MOVE YOUR CAR TO A WELL-VENTILATED AREA.

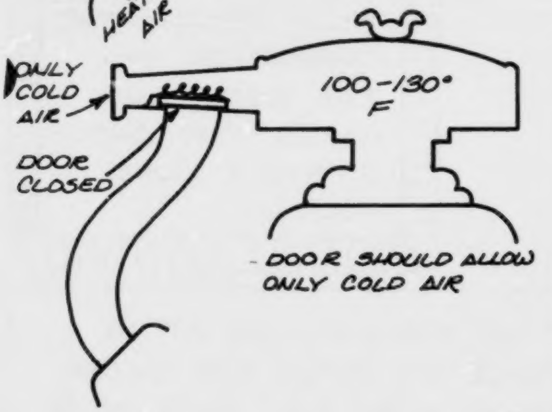
IF YOU HAVE THE SNORKEL WITH THE CAN ON IT, THE DOOR SHOULD BE CLOSED WITH THE ENGINE RUNNING. THIS MEANS HEATED AIR IS BEING PULLED INTO THE CARBURETOR. THE SAME IS TRUE FOR THE SYSTEM WITHOUT THE SMALL CAN ON THE SNORKEL.

TO CHECK, CAREFULLY TOUCH THE PIPE RUNNING FROM THE BOTTOM OF THE SNORKEL TO THE EXHAUST MANIFOLD, IT SHOULD BE WARMING UP PRETTY FAST.


SHOULD BEGIN TO WARM UP QUICKLY
VEG


DOORS SHOULD OPEN AS ENGINE WARMS UP
COLD AIR
HEATED AIR MIXES WITH COOLER AIR
HEATED AIR

NOW BE PATIENT AND WATCH THE DOOR AS THE ENGINE WARMS UP. IF EVERYTHING IS WORKING PROPERLY THE DOOR SHOULD BEGIN TO OPEN AND ALLOW COLD AIR TO ENTER AND MIX WITH THE HEATED AIR.

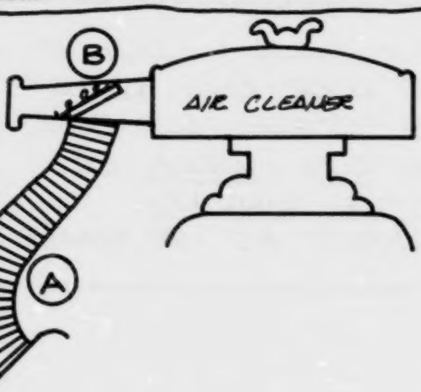

ONLY COLD AIR
100-130° F
DOOR CLOSED
DOOR SHOULD ALLOW ONLY COLD AIR

THE DOOR SHOULD CONTINUE TO OPEN AS THE ENGINE WARMS UP. FACT IS, IT SHOULD COMPLETELY BLOCK OFF THE HEATED AIR WHEN THE TEMPERATURE INSIDE THE AIR CLEANER IS SOMEWHERE BETWEEN 100° - 130° F.

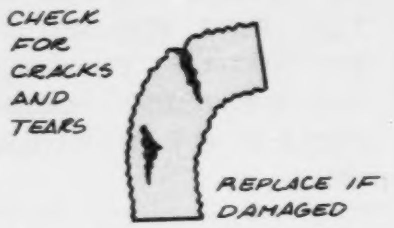
THAT IS THE WAY YOUR SYSTEM SHOULD OPERATE. LET ME TAKE YOU A LITTLE FARTHER NOW AND TELL YOU WHAT TO CHECK IF IT IS NOT WORKING RIGHT.

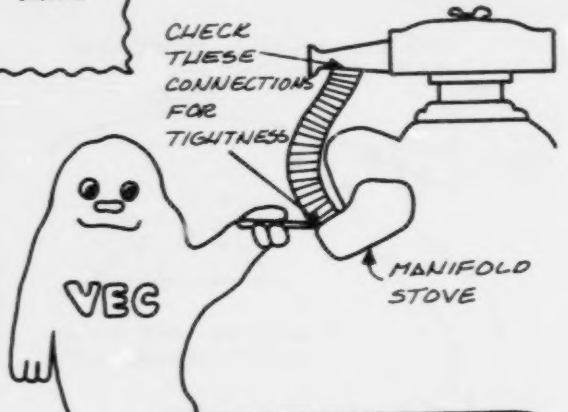
LET'S....

LOOK AT THE PARTS THAT ARE **COMMON TO BOTH SYSTEMS.** FIRST, THESE PARTS ARE: THE Ⓐ HEATED AIR INLET DUCT, AND THE Ⓑ DOOR IN THE SNORKEL TUBE.


B
AIR CLEANER
A

CHECK THE HEATED AIR INLET DUCT FOR CRACKS OR TEARS. CHECK TO SEE IF IT FITS TIGHTLY OVER THE CONNECTION ON THE MANIFOLD STOVE. (I'M POINTING TO THAT PART.) CHECK THE CONNECTION WHERE IT ATTACHES TO THE AIR CLEANER SNORKEL.


CHECK FOR CRACKS AND TEARS
REPLACE IF DAMAGED

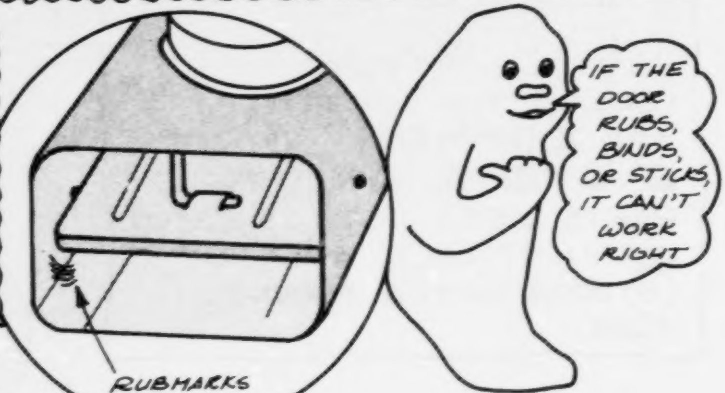

CHECK THESE CONNECTIONS FOR TIGHTNESS
VEG
MANIFOLD STOVE

IF THESE ARE NOT TIGHT AND IN POSITION, OR TEARS AND CRACKS ARE PRESENT, COLD AIR CAN BE DRAWN IN AT THESE POINTS. (IT'S LIKE WEARING A COAT BUT NOT BUTTONING IT.)

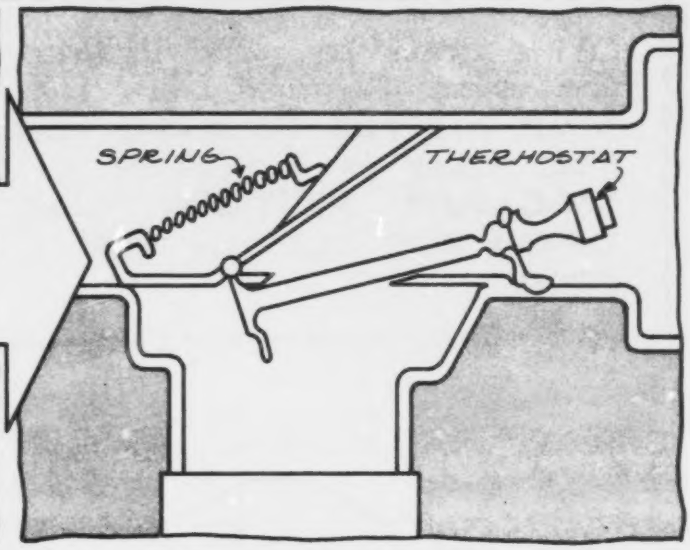
THIS DELAYS THE OPERATION OF THE DOOR AND MAKES THE WHOLE SYSTEM WORK POORLY.

THE NEXT PART WE SHOULD LOOK AT IS THE DOOR. IN ORDER TO OPEN AND CLOSE PROPERLY, THE DOOR MUST NOT RUB OR BE JAMMED AGAINST THE SNORKEL TUBE.

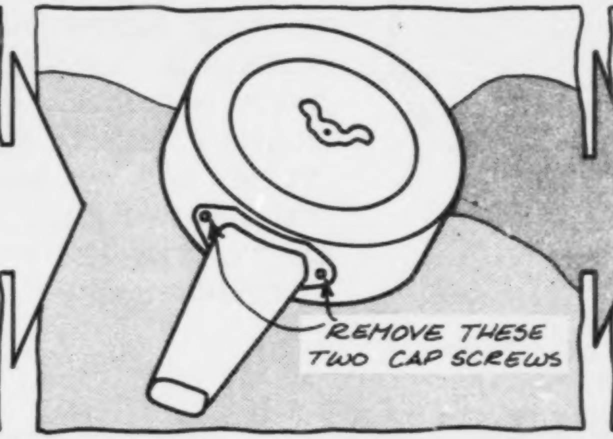
NOW, TAKE A LOOK AT THE DOOR AND INSIDE THE SNORKEL AND CHECK FOR RUB MARKS OR OBVIOUS BINDING. CORRECT AS NECESSARY.


RUBMARKS
IF THE DOOR RUBS, BINDS, OR STICKS, IT CAN'T WORK RIGHT

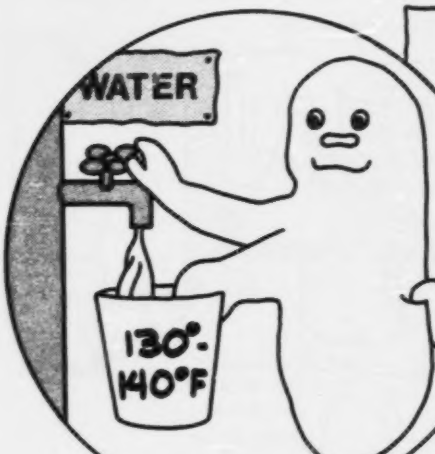
LET'S LOOK AT THE HEATED AIR SYSTEM THAT DOESN'T HAVE THE "CAN" ON THE SNORKEL. THE DOOR ON THIS ONE IS OPERATED BY A THERMOSTAT THAT IS SENSITIVE TO AIR TEMPERATURE.


SPRING
THERMOSTAT

IF YOU HAVE THIS TYPE AND IT DOESN'T WORK PROPERLY, CHECK AND MAKE SURE THAT THE DOOR ISN'T BINDING.

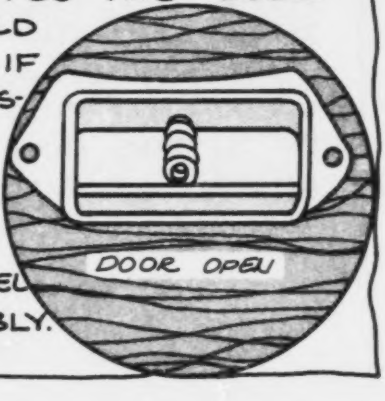

REMOVE THESE TWO CAP SCREWS

IF THE DOOR ISN'T BINDING, REMOVE THE TWO CAP SCREWS HOLDING THE SNORKEL TUBE ON.

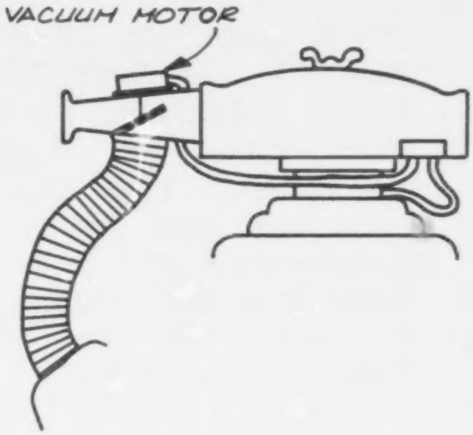

WATER
130°-140°F

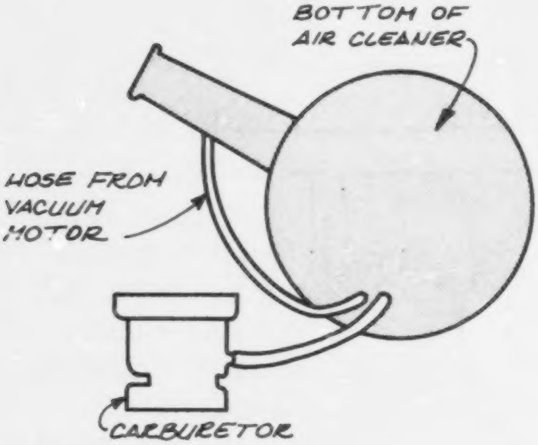
NEXT - FIND A BUCKET LARGE ENOUGH TO HOLD THE SNORKEL UNIT. FILL IT WITH WATER THAT IS ABOUT 130° F.

SET THE SNORKEL INTO THE WATER SO THE THERMOSTAT IS UNDER WATER. AFTER IT HAS SET FOR A FEW MINUTES THE DOOR SHOULD OPEN. IF IT DOESN'T, YOU NEED A NEW SNORKEL ASSEMBLY.



LET'S LOOK AT THE HEATED AIR SYSTEM THAT HAS THE "CAN" ON THE SNORKEL TUBE. THE "CAN" IS ACTUALLY A **VACUUM MOTOR** THAT OPENS AND CLOSES THE DOOR.

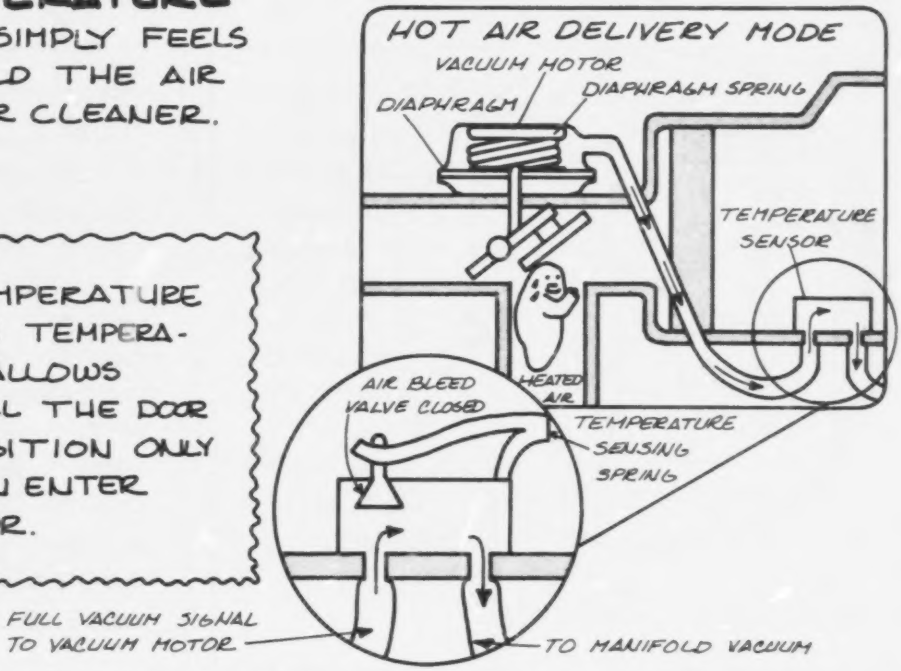

VACUUM MOTOR


BOTTOM OF AIR CLEANER
HOSE FROM VACUUM MOTOR
CARBURETOR

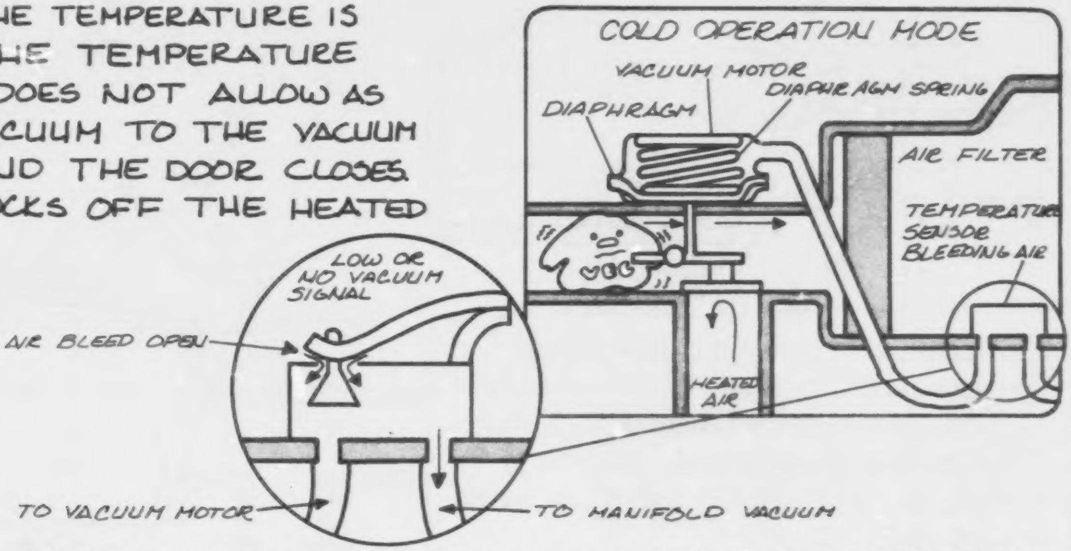
TAKE OFF THE AIR CLEANER ASSEMBLY. NOW FOLLOW THE HOSE FROM THE VACUUM MOTOR TO THE BOTTOM OF THE AIR CLEANER. NOTICE THAT IT SLIPS OVER A SMALL METAL TUBE. RIGHT? NEXT TO THAT SMALL TUBE SHOULD BE ANOTHER HOSE. THIS HOSE SHOULD BE CONNECTED TO THE BOTTOM OF THE CARBURETOR.

THE GADGET THE TWO HOSES CONNECT TO IS CALLED A **TEMPERATURE SENSOR**. IT SIMPLY FEELS HOW HOT OR COLD THE AIR IS INSIDE THE AIR CLEANER.

WHEN THE TEMPERATURE IS **COLD,** THE TEMPERATURE SENSOR ALLOWS VACUUM TO PULL THE DOOR UP. IN THIS POSITION ONLY HEATED AIR CAN ENTER THE CARBURETOR.


HOT AIR DELIVERY MODE
VACUUM MOTOR
DIAPHRAGM
DIAPHRAGM SPRING
TEMPERATURE SENSOR
HEATED AIR
AIR BLEED VALVE CLOSED
TEMPERATURE SENSING SPRING
FULL VACUUM SIGNAL TO VACUUM MOTOR
TO MANIFOLD VACUUM

WHEN THE TEMPERATURE IS **HOT** THE TEMPERATURE SENSOR DOES NOT ALLOW AS MUCH VACUUM TO THE VACUUM MOTOR AND THE DOOR CLOSES. THIS BLOCKS OFF THE HEATED AIR.


COLD OPERATION MODE
VACUUM MOTOR
DIAPHRAGM SPRING
DIAPHRAGM
AIR FILTER
TEMPERATURE SENSOR BLEEDING AIR
LOW OR NO VACUUM SIGNAL
AIR BLEED OPEN
HEATED AIR
TO VACUUM MOTOR
TO MANIFOLD VACUUM

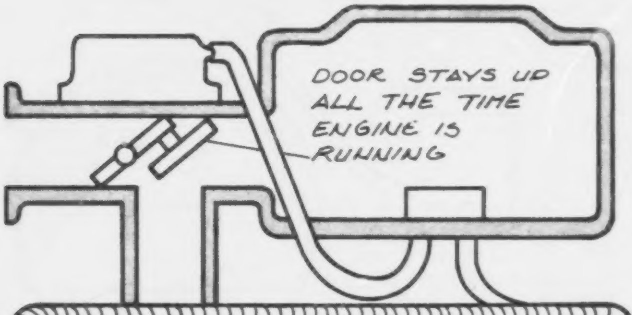
* * *

NOW THAT YOU KNOW WHAT THE PARTS ARE, LET ME EXPLAIN HOW TO PINPOINT WHICH ONE MAY BE GIVING YOU PROBLEMS.

READY??...

1st PROBLEM

THE DOOR COMES UP WHEN YOU START YOUR ENGINE, BUT NEVER COMES BACK DOWN NO MATTER HOW HOT IT GETS, UNTIL YOU SHUT THE ENGINE OFF.

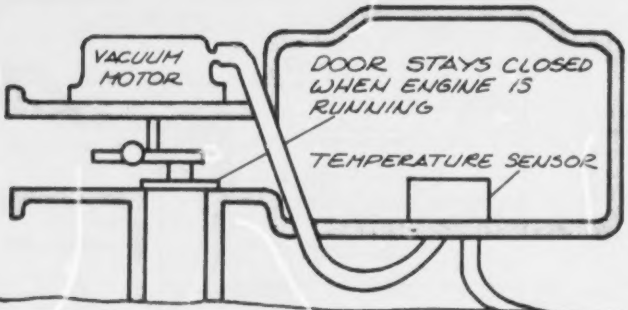

DOOR STAYS UP ALL THE TIME ENGINE IS RUNNING

SOLUTION

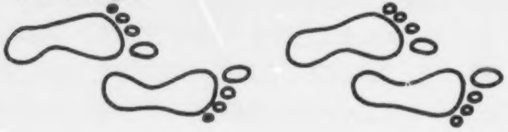
THIS ONE IS EASY, RIGHT? THE FACT THAT IT STAYS UP WHEN THE ENGINE IS RUNNING TELLS US THE TEMPERATURE SENSOR IS NOT DOING ITS JOB. BETTER REPLACE IT.

2nd PROBLEM

THE DOOR DOES NOT MOVE WHEN YOU START THE ENGINE EVEN IF IT IS VERY COLD. IT JUST SITS THERE. (SEE ILLUSTRATIONS NEXT PAGE.)


VACUUM MOTOR
DOOR STAYS CLOSED WHEN ENGINE IS RUNNING
TEMPERATURE SENSOR

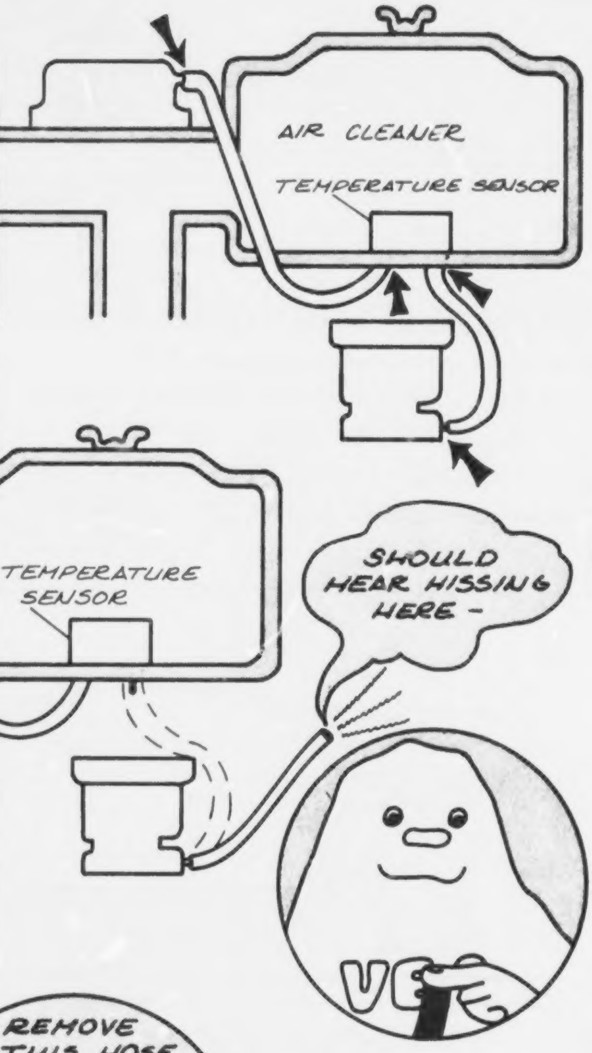
I WOULD RECOMMEND YOU TAKE THE FOLLOWING STEPS:



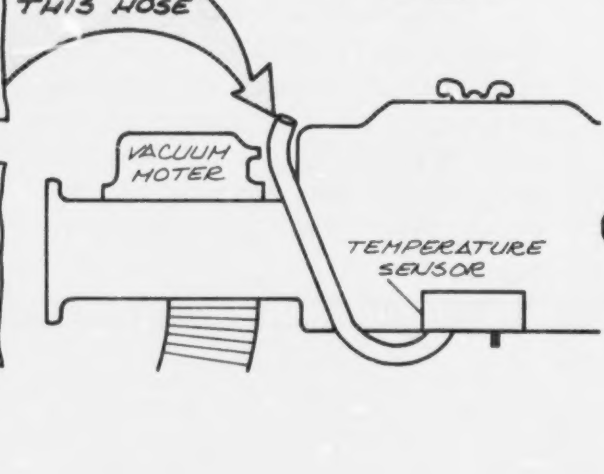
1. CHECK THE VACUUM LINE CONNECTIONS. (NO CRACKED OR BROKEN HOSES ALLOWED. NO KINKS OR SLOPPY FITS, EITHER!) IF THE HOSE IS O.K......

THEN

2. **WITH THE ENGINE RUNNING,** REMOVE THE HOSE THAT GOES FROM THE CARBURETOR TO THE TEMPERATURE SENSOR. REMOVE IT **AT** THE TEMPERATURE SENSOR. A HISSING NOISE INDICATES SOME VACUUM.

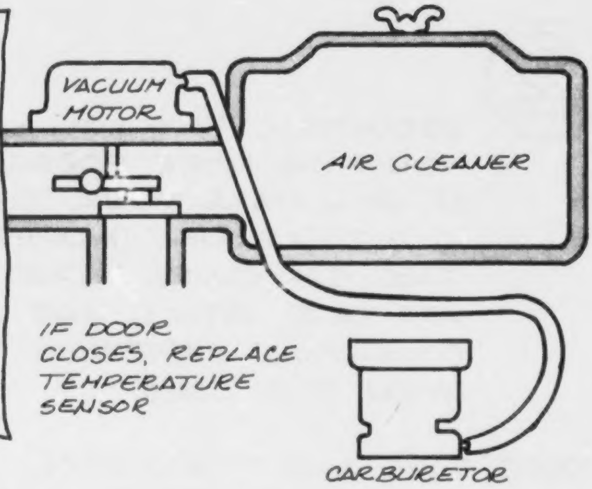

AIR CLEANER
TEMPERATURE SENSOR
TEMPERATURE SENSOR
SHOULD HEAR HISSING HERE -
VC

3. PUT YOUR FINGER OVER THE END OF THE HOSE. IT SHOULD TRY TO STICK TO YOUR FINGER IF YOU HAVE VACUUM AVAILABLE. IF NOT, BETTER FIND OUT WHAT IS KEEPING VACUUM FROM GETTING TO THE SENSOR!


REMOVE THIS HOSE
VACUUM MOTER
TEMPERATURE SENSOR

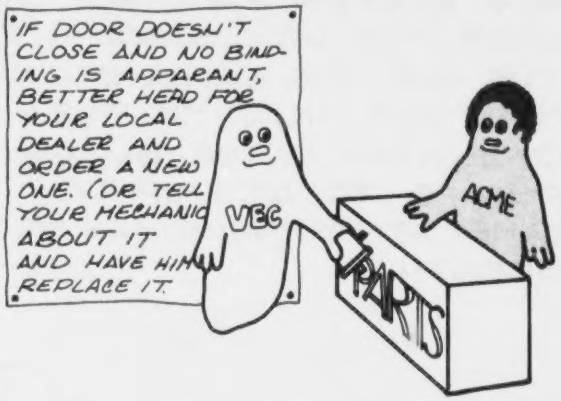
4. IF YOU HAVE VACUUM AT THE HOSE, NEXT REMOVE THE HOSE OFF THE VACUUM MOTOR.

5. PLUG THE HOSE FROM THE CARBURETOR INTO THE VACUUM MOTOR. **WATCH THE DOOR;** IF IT CLOSES, AND THEN OPENS WHEN YOU REMOVE THE VACUUM HOSE, THE VACUUM MOTOR IS O.K. YOU NEED A NEW TEMPERATURE SENSOR.



IF DOOR CLOSES, REPLACE TEMPERATURE SENSOR

6. IF THE DOOR DOESN'T CLOSE WHEN YOU HOOK THE VACUUM HOSE TO IT, YOU PROBABLY NEED A NEW VACUUM MOTOR. CHECK AGAIN FOR BINDING. IF NOTHING APPEARS TO BE JAMMED, YOU BETTER ORDER THE NEW VACUUM MOTOR.

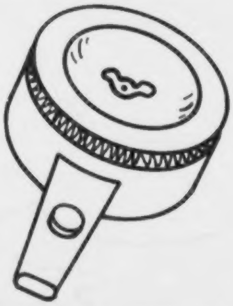


IF DOOR DOESN'T CLOSE AND NO BINDING IS APPARANT, BETTER HEAD FOR YOUR LOCAL DEALER AND ORDER A NEW ONE. (OR TELL YOUR MECHANIC ABOUT IT AND HAVE HIM REPLACE IT.

Wasn't As Tough As You Thought It Would Be, Was It?

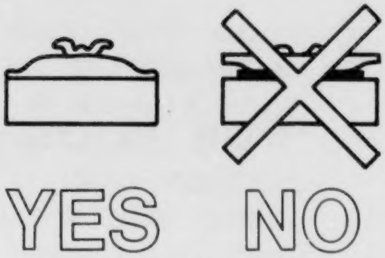
A COUPLE OF WORDS OF CAUTION

① **DON'T** TURN OVER YOUR TOP LID ON THE AIR CLEANER. FIRST OF ALL, THIS WILL NOT GIVE YOU FIVE MORE MILES PER GALLON.

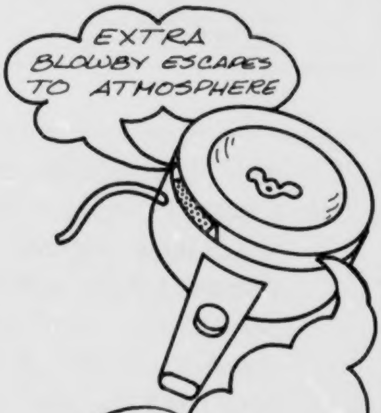


NOTHING IS TO BE GAINED

② SECONDLY, THIS WILL NOT GIVE YOU FIVE MORE HORSEPOWER. IT WILL MAKE YOUR THERMOSTATIC AIR CLEANER INOPERATIVE. THIS CAN CAUSE YOUR CAR TO HESITATE, STALL, AND JUST BE DOWNRIGHT MISERABLE TO DRIVE WHEN IT'S COLD.



TAKE TIME AND THINK BACK ABOUT THE PCV SYSTEM. REMEMBER THE FILTER INSIDE THE AIR CLEANER? THAT'S RIGHT, THE ONE THE EXTRA BLOWBY GASES CAME OUT OF. WITH THE LID TURNED OVER THAT EXTRA BLOWBY GAS CAN ESCAPE TO ATMOSPHERE. THAT IS THE SAME ATMOSPHERE WE'VE ALL GOT TO BREATH.


EXTRA BLOWBY ESCAPES TO ATMOSPHERE

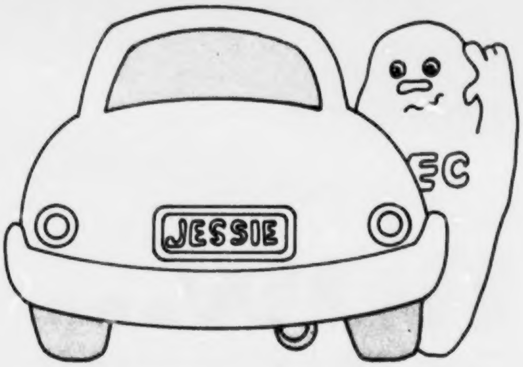
MANY CARS HAVE OTHER TEMPERATURE SENSORS ON THE AIR CLEANER HOUSING. FLIPPING THAT LID OVER MESSES THESE UP, TOO! THIS CAN ACTUALLY COST YOU GAS MILEAGE, NOT TO MENTION THE EXTRA EMISSIONS YOUR CAR WILL BE PUTTING OUT.

AIR INJECTION
REACTION SYSTEMS

AIR
INJECTION
SYSTEMS

THE NEXT SYSTEM I WOULD LIKE TO TELL YOU ABOUT IS THE A.I.R. SYSTEM. THE LETTERS A.I.R. STAND FOR AIR INJECTION REACTION.

THE A.I.R. SYSTEM HAS BEEN USED BY THE AUTO INDUSTRY SINCE THE MID-1960'S. IT HAS NOT BEEN USED ON ALL CARS, SO YOUR CAR MAY OR MAY NOT HAVE AN A.I.R. SYSTEM. WE WILL CHECK THAT OUT IN A FEW MINUTES.

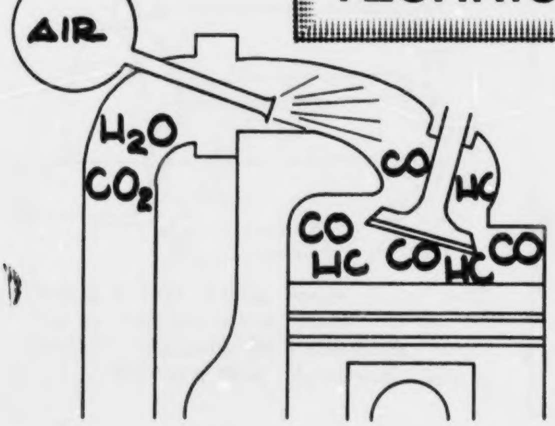


TRADE NAMES

AMC → AIR GUARD
CHRYSLER → AIR INJECTION
FORD → THERMACTOR
GM → A.I.R.

THE A.I.R. SYSTEM IS CALLED BY DIFFERENT NAMES. AMERICAN MOTORS (AMC) CALLS IT **AIR GUARD.** CHRYSLER CALLS IT **AIR INJECTION.** FORD USES **THERMACTOR** AND GENERAL MOTORS (GM) CALLS IT **A.I.R.** DON'T BE CONFUSED BY THE NAMES! THE SYSTEM DOES THE SAME JOB NO MATTER WHAT IT IS CALLED.

TECHNICAL INFORMATION AHEAD



THE A.I.R. SYSTEM'S JOB IS TO REDUCE THE HC AND CO EMISSIONS FROM THE ENGINE. IT DOES THIS BY INJECTING A STREAM OF FRESH AIR INTO THE EXHAUST GASES LEAVING EACH CYLINDER.

Preceding page blank

IT'S JUST LIKE BLOWING INTO FIRE TO HAVE IT BURN BETTER

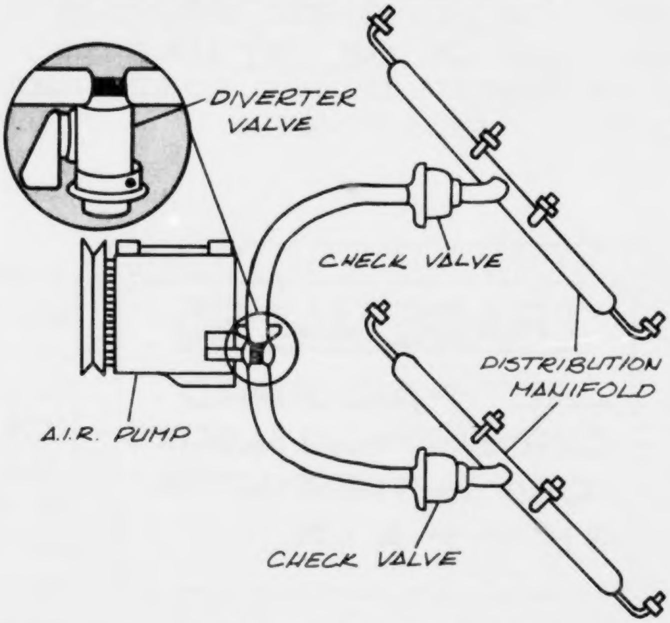
THIS "EXTRA" AIR HELPS TO KEEP THE FIRE BURNING. THIS BURNS UP THE UNBURNED HYDROCARBONS (HC) AND CARBON MONOXIDE (CO.) WHAT WE GET COMING OUT THE TAILPIPE THEN IS PLAIN WATER VAPOR (H_2O) AND CARBON DIOXIDE (CO_2)

THAT WASN'T AS COMPLICATED AS YOU GUESSED, WAS IT ?

now...

THAT WE KNOW WHAT THE SYSTEM DOES, LETS HEAD OUT AND SEE IF WE CAN FIND SOME OF THE AIR SYSTEM PARTS ON YOUR CAR THAT ARE SHOWN HERE.

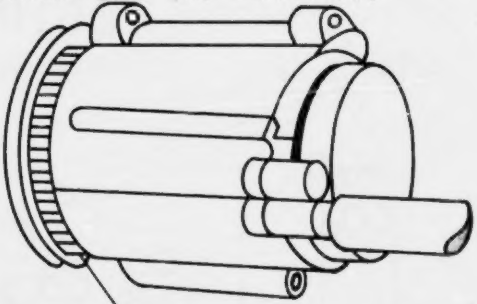
TYPICAL V-8 ENGINE SET-UP


DIVERTER VALVE
CHECK VALVE
DISTRIBUTION MANIFOLD
A.I.R. PUMP
CHECK VALVE

THE FIRST PART WE WANT TO CHECK FOR IS THE **A.I.R. PUMP** LOOK AT THE FRONT OF YOUR ENGINE WHERE ALL THE BELTS ARE. THE A.I.R. PUMP WILL BE DRIVEN BY A BELT. THERE WILL ALSO BE ONE OR TWO HOSES COMING OFF THE BACK OF THE PUMP

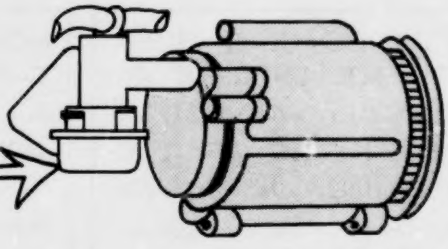
I'LL ASSUME YOU FOUND IT. IF YOU DIDN'T, YOUR CAR PROBABLY DOESN'T HAVE AN A.I.R. SYSTEM.

THE A.I.R. PUMP IS ABOUT THE SAME SIZE AS YOUR ALTERNATOR, EXCEPT THAT THERE ARE NO WIRES COMING OFF THE A.I.R. PUMP.



THE A.I.R. PUMP ALSO HAS A LITTLE PLASTIC THING WITH HOLES IN IT JUST BEHIND THE PULLEY. THIS IS A CENTRIFUGAL AIR FILTER.

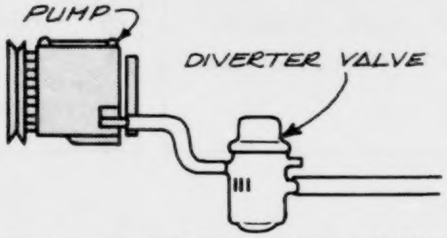
THE NEXT PART TO FIND IS CALLED A **DIVERTER VALVE.** THIS CAN BE ATTACHED RIGHT ON THE BACK OF THE PUMP LIKE THE ONE I'M POINTING TO HERE.



PUMP - DIVERTER ASSEMBLY
G.M. AND SOME CHRYSLERS

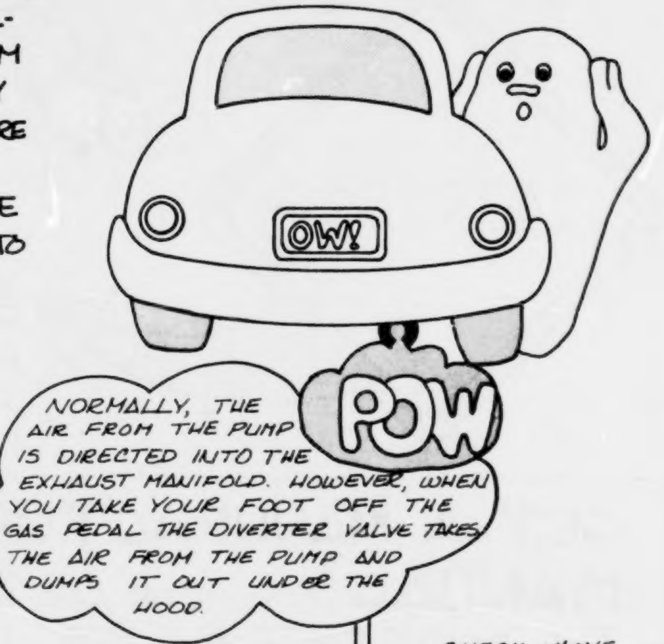
OR

IT MAY BE FURTHER DOWN THE HOSE COMING FROM THE A.I.R. PUMP LIKE THE ONE I'M SHOWING YOU HERE.


PUMP
DIVERTER VALVE

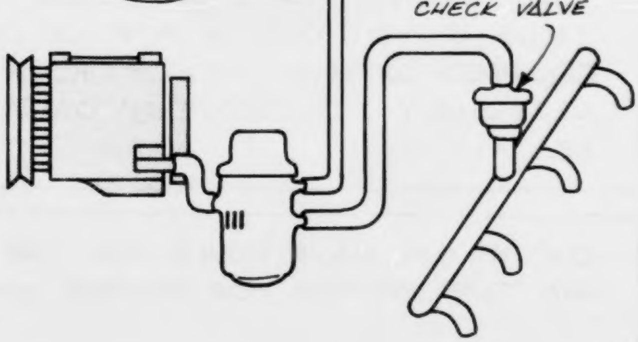
PUMP - DIVERTER VALVE ASSEMBLY
A.M.C. AND FORD

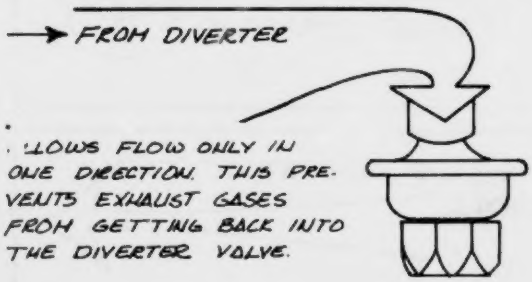
THE PURPOSE OF THE DIVERTER VALVE IS TO PREVENT A BACKFIRE. IT TAKES THE AIR FROM THE PUMP AND MOMENTARILY DUMPS IT INTO THE ATMOSPHERE WHEN YOU TAKE YOUR FOOT OFF THE GAS. NORMALLY THE AIR FROM THE PUMP GOES INTO THE EXHAUST MANIFOLD.


OW!
POW
NORMALLY, THE AIR FROM THE PUMP IS DIRECTED INTO THE EXHAUST MANIFOLD. HOWEVER, WHEN YOU TAKE YOUR FOOT OFF THE GAS PEDAL THE DIVERTER VALVE TAKES THE AIR FROM THE PUMP AND DUMPS IT OUT UNDER THE HOOD.

find it?

NOW FOLLOW THE HOSE OR HOSES ON DOWN FROM THE DIVERTER VALVE. YOU SHOULD COME TO A **CHECK VALVE** THAT LOOKS LIKE THIS.....

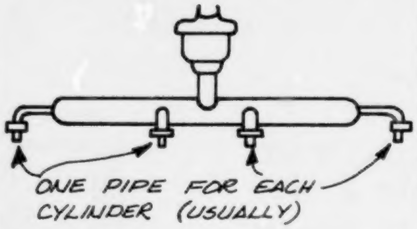

CHECK VALVE


FROM DIVERTER

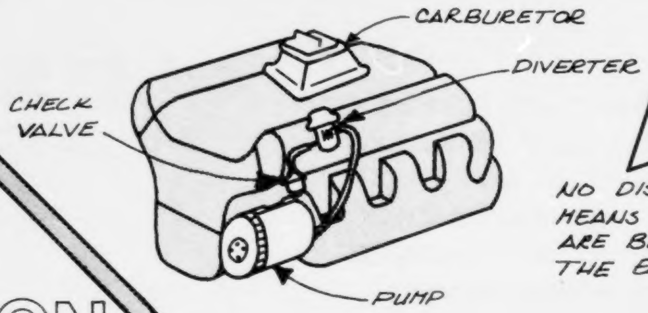
LLOWS FLOW ONLY IN ONE DIRECTION. THIS PREVENTS EXHAUST GASES FROM GETTING BACK INTO THE DIVERTER VALVE.

ON SOME V-8'S THERE WILL BE A CHECK VALVE FOR EACH SIDE OF THE ENGINE. ON OTHER V-8'S THERE WILL BE ONLY ONE CHECK VALVE. ON 4 AND 6 CYLINDER ENGINES ONLY ONE CHECK VALVE IS NORMALLY USED.

NOW EITHER THAT CHECK VALVE IS SCREWED INTO THE ENGINE OR IT IS ATTACHED TO A DISTRIBUTION MANIFOLD LIKE THIS:



IF IT IS SCREWED INTO THE ENGINE ITSELF, THAT MEANS AIR PASSAGES ARE BUILT RIGHT INTO THE ENGINE AND LEAD TO EACH CYLINDER'S EXHAUST PASSAGE.



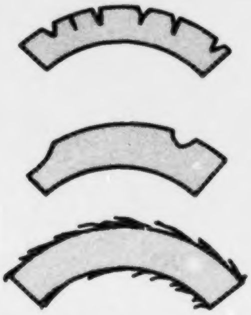
NO DISTRIBUTION TUBES MEANS THE AIR PASSAGES ARE BUILT RIGHT INTO THE ENGINE.

ONE WORD OF CAUTION: IF THERE ARE PARTS MISSING, OR MORE PARTS THAN WE'VE TALKED ABOUT, TAKE THE FOLLOWING ACTION:

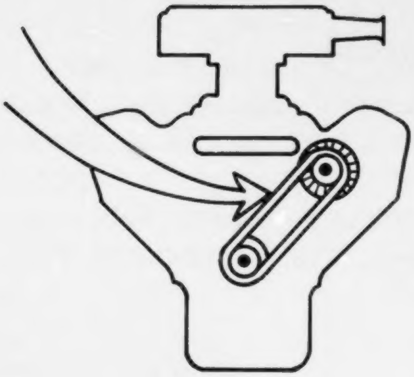
GET A MANUFACTURER'S SERVICE MANUAL FOR YOUR CAR AND FIND OUT WHAT THE "EXTRA" PARTS ARE FOR. THIS IS ESPECIALLY TRUE IF YOU OWN A 1975 OR NEWER VEHICLE EQUIPPED WITH A CATALYTIC CONVERTER. THIS IS NECESSARY TO PREVENT DAMAGING THESE CONVERTERS.

O.K. IF WE HAVE FOUND ALL THE PARTS, WE CAN START CHECKING THE SYSTEM FOR PROPER OPERATION.

1. FIRST OF ALL, CHECK THE DRIVE BELT FOR THE AIR PUMP. TURN IT OVER AND CHECK FOR (a.) CRACKS, (b.) PIECES MISSING, (c.) FRAYS, IF YOU FIND ANY OF THESE CONDITIONS, REPLACE THE BELT.

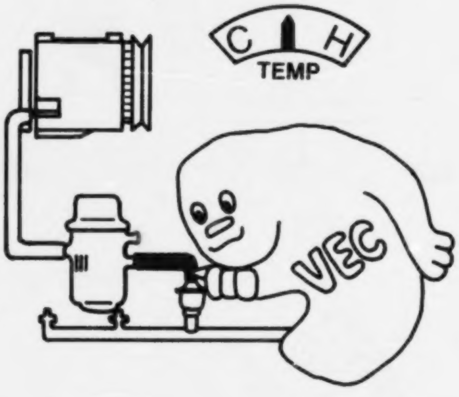


2. NEXT CHECK AND SEE IF THE BELT IS TIGHT. IF IT IS OBVIOUSLY LOOSE, TIGHTEN IT. THE BELT SHOULD NOT BE SO TIGHT THAT IT "TWANGS" LIKE A GUITAR STRING.

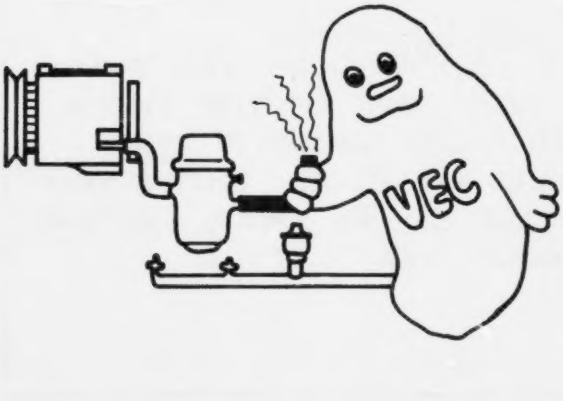


NOTE - DON'T PRY ON THE A.I.R. PUMP HOUSING. PRY ON ONE END OR THE OTHER BUT NOT THE MIDDLE. A.I.R. PUMPS ARE EXPENSIVE.

WARNING: MAKE SURE YOU ARE WORKING IN A WELL VENTILATED AREA.



3. START THE ENGINE AND LET IT WARM TO IT'S NORMAL OPERATING TEMPERATURE. USING THE PROPER TOOL, LOOSEN THE CLAMP THAT HOLDS THE HOSE TO THE CHECK VALVE. CAUTION: KEEP HANDS CLEAR OF BELTS, FAN BLADES, AND OTHER MOVING PARTS.



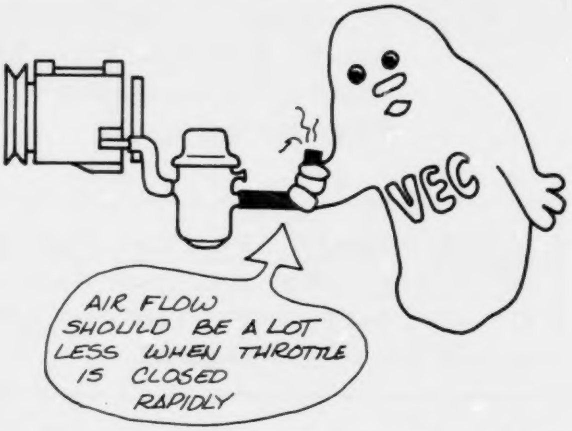
THERE SHOULD BE AIR FLOWING OUT OF THE HOSE.

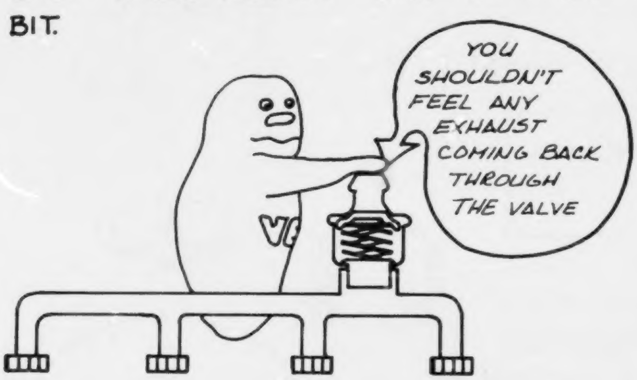
NOW, SPEED UP THE ENGINE. THE AIR FLOW SHOULD INCREASE.

LET'S CHECK OUT THE DIVERTER VALVE NEXT.

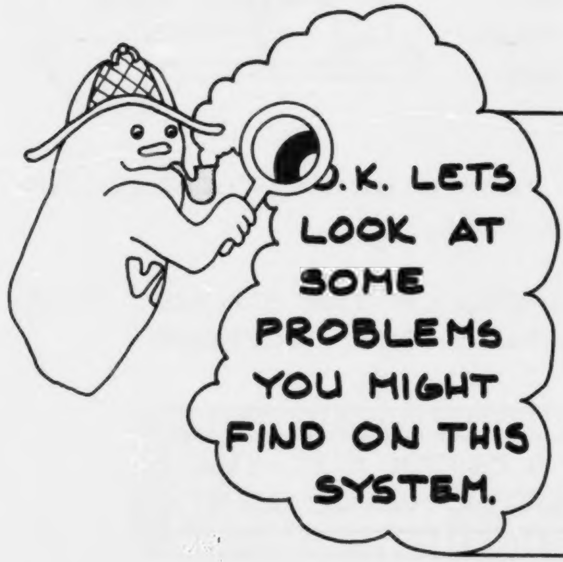
WE SAID THE DIVERTER VALVE DUMPED THE AIR FROM THE PUMP WHEN YOU LIFT YOUR FOOT OFF THE GAS PEDAL, RIGHT? WELL, LET'S FIND OUT IF IT'S WORKING.

1. AGAIN INCREASE ENGINE SPEED AND THEN LET THE THROTTLE SNAP SHUT. WHEN THE THROTTLE CLOSES, AIR FLOW FROM THE HOSE YOU ARE HOLDING SHOULD DECREASE OR STOP FOR 1-3 SECONDS. IF IT DOESN'T, SOMETHING IS WRONG. WE WILL TALK ABOUT THIS IN A LITTLE BIT.

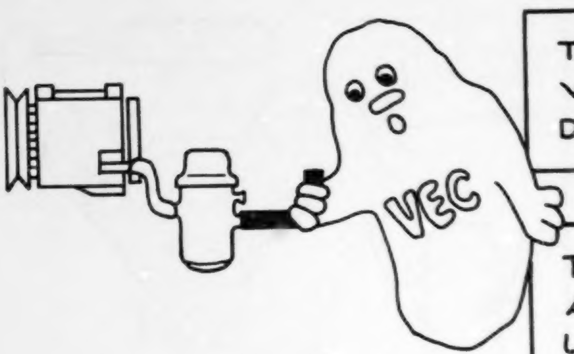

VEC
AIR FLOW SHOULD BE A LOT LESS WHEN THROTTLE IS CLOSED RAPIDLY


YOU SHOULDN'T FEEL ANY EXHAUST COMING BACK THROUGH THE VALVE
VE

NEXT, TAKE A LOOK AT THE CHECK VALVE YOU HAVE PULLED THE HOSE OFF OF. HOLD YOUR HAND OVER IT **(CAREFULLY)** AND SEE IF YOU CAN FEEL HOT EXHAUST GAS ESCAPING. IF YOU CAN, THE CHECK VALVE SHOULD BE REPLACED. IF YOU HAVE TWO CHECK VALVES YOU MIGHT WANT TO CHECK THE OTHER ONE, TOO.

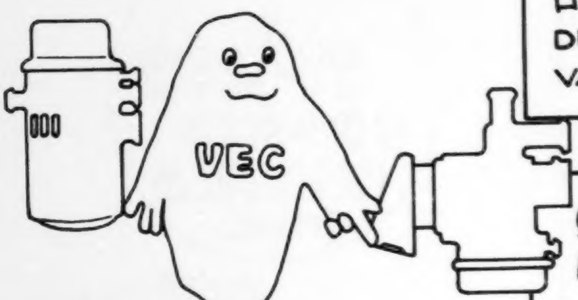

O.K. LETS LOOK AT SOME PROBLEMS YOU MIGHT FIND ON THIS SYSTEM.
V

Problem 1: YOU PULL THE HOSE OFF OF THE CHECK VALVE AND THERE IS VERY LITTLE AIR FLOW. WHEN YOU INCREASE ENGINE SPEED, AIR FLOW INCREASES VERY LITTLE.



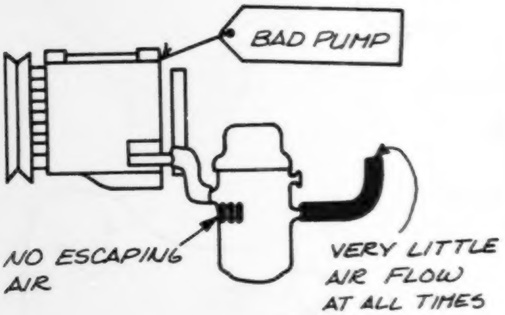
THE PROBLEM MAY BE THE DIVERTER VALVE. IN OTHER WORDS, IT IS DUMPING PUMP AIR ALL THE TIME.

TO CHECK – TAKE A CLOSE LOOK AT YOUR DIVERTER. MOST WILL LOOK LIKE ONE OF THE TWO I'M POINTING TO HERE. NOTICE THE HOLES. THIS IS WHERE THE AIR IS DUMPED OUT OF THE DIVERTER VALVE.



IF AIR IS COMING OUT OF THESE HOLES ALL THE TIME, YOU NEED A NEW DIVERTER VALVE.

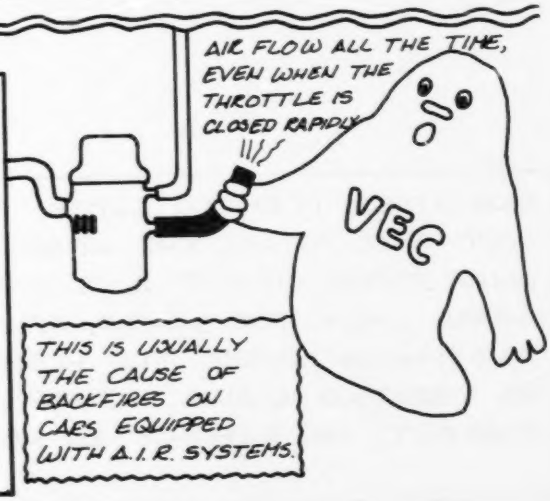
CAUTION - WATCHING OUT FOR MOVING BLADES, BELTS AND PULLEYS. PUT YOUR FINGERS DOWN BY THOSE HOLES. IF YOU CAN FEEL AIR ESCAPING ALL THE TIME, THE DIVERTER VALVE NEEDS REPLACING.


BAD PUMP
NO ESCAPING AIR
VERY LITTLE AIR FLOW AT ALL TIMES

IF AIR IS NOT ESCAPING OUT OF THE DIVERTER VALVE, AND THE FLOW OUT OF THE HOSE IS VERY LOW, YOU PROBABLY NEED A NEW AIR PUMP.

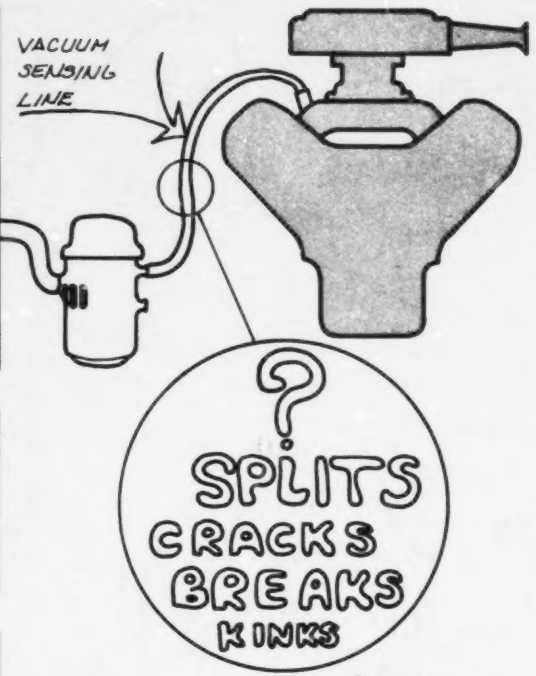
Problem 2:

THE DIVERTER VALVE DOES NOT PUMP AIR WHEN YOU TAKE YOUR FOOT OFF THE GAS. WHEN YOU CHECKED THE DIVERTER VALVE OPERATION, THE FLOW OF AIR OUT OF THE HOSE DID NOT DECREASE AT ALL.


AIR FLOW ALL THE TIME, EVEN WHEN THE THROTTLE IS CLOSED RAPIDLY

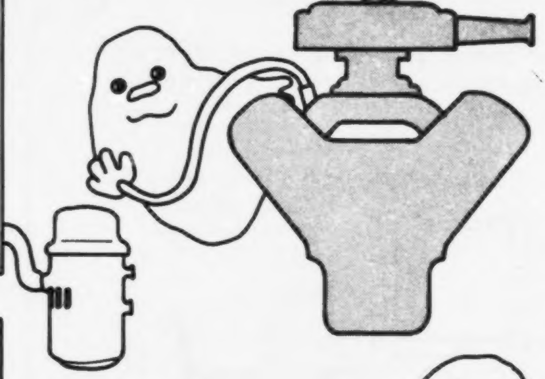
THIS IS USUALLY THE CAUSE OF BACKFIRES ON CARS EQUIPPED WITH A.I.R. SYSTEMS.

FIRST THING I'D RECOMMEND YOU DO IS CHECK THE VACUUM SENSING LINE. THIS IS THE SMALL RUBBER HOSE THAT RUNS FROM THE DIVERTER VALVE UP TO SOME PLACE ON THE INTAKE MANIFOLD. THIS LINE SENSES INTAKE MANIFOLD VACUUM. CHANGES IN INTAKE MANIFOLD VACUUM OPERATE THE DIVERTER VALVE.



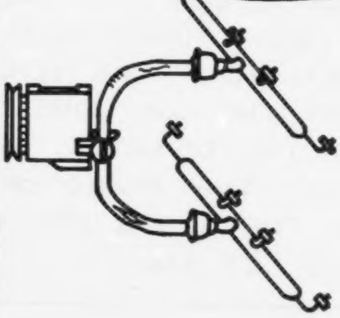
FIND IT? CHECK THIS HOSE FOR SPLITS, CRACKS, KINKS, OR BREAKS AND LOOSE CONNECTIONS. REPLACE IF NECESSARY.

NEXT – REMOVE THE HOSE AT THE DIVERTER VALVE. CHECK AND SEE IF YOU HAVE VACUUM. IF YOUR FINGER STICKS TO THE END OF THE HOSE, YOU'RE ALL SET. IF NOT, BETTER CORRECT THE PROBLEM AND THEN RECHECK THE DIVERTER VALVE OPERATION.



IF IT STILL DOESN'T WORK, I'M AFRAID YOU NEED A NEW DIVERTER VALVE.

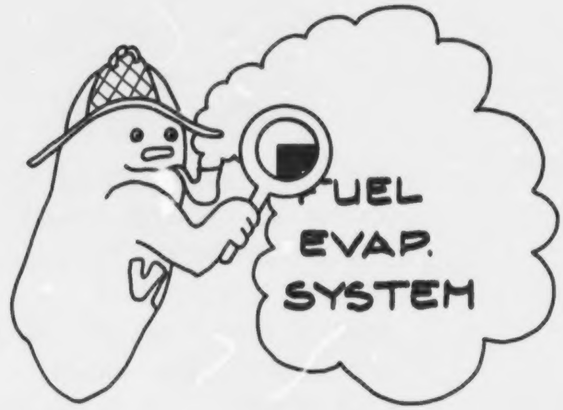
ONE OTHER ITEM TO CHECK! TAKE A GOOD LOOK AT ALL THE HOSES AND CONNECTIONS ON THE A.I.R. SYSTEM. AGAIN, CHECK FOR CRACKS, SPLITS, KINKS, AND PLACES WHERE THE HOSES MAY BE VIBRATING AGAINST SHARP EDGES. CORRECT AND REPLACE AS NEEDED.



THE A.I.R. SYSTEM IS VERY EFFECTIVE IN REDUCING HC AND CO EMISSIONS. IT TAKES VERY LITTLE POWER (A LOT LESS THAN YOUR CAR'S AIR CONDITIONING) TO DRIVE THE A.I.R. PUMP. IT ALSO TAKES VERY LITTLE MAINTAINENCE TO KEEP THIS SYSTEM OPERATING, AND BY KEEPING IT WORKING RIGHT YOU ARE HELPING TO KEEP OUR AIR CLEAN.

FUEL EVAPORATIVE
CONTROL SYSTEMS

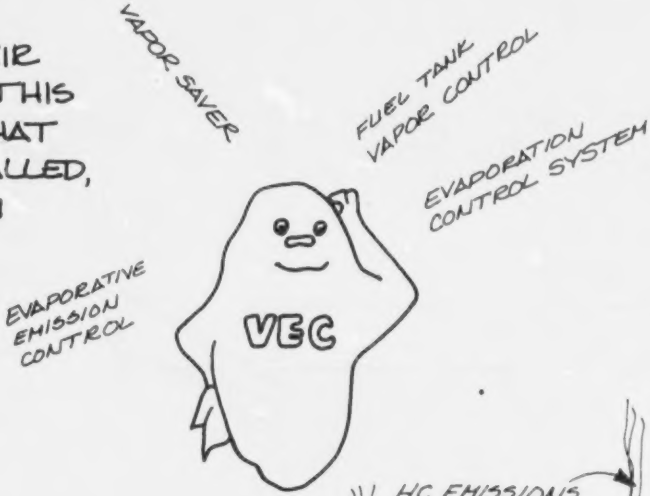
Preceding page blank


FUEL
EVAP.
SYSTEM

NOW LET'S TAKE TIME TO LOOK AT A SYSTEM THAT IS ABBREVIATED F.E.C. THE LETTERS F.E.C. STAND FOR

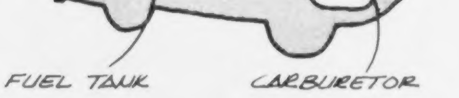
FUEL EVAPORATION CONTROL.

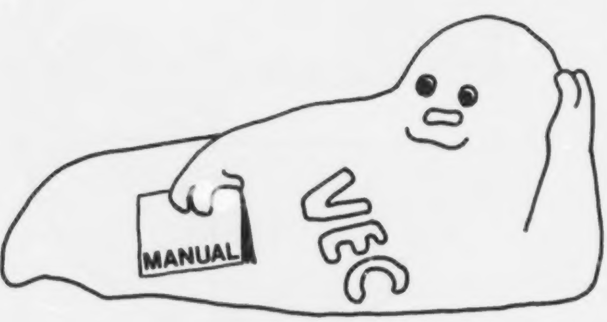
EACH CAR MAKER HAS THEIR OWN SPECIAL NAME FOR THIS SYSTEM. THE POINT IS THAT NO MATTER WHAT IT IS CALLED, IT'S JOB IS THE SAME ON EVERY CAR.


VAPOR SAVER
FUEL TANK VAPOR CONTROL
EVAPORATION CONTROL SYSTEM
EVAPORATIVE EMISSION CONTROL
VEC

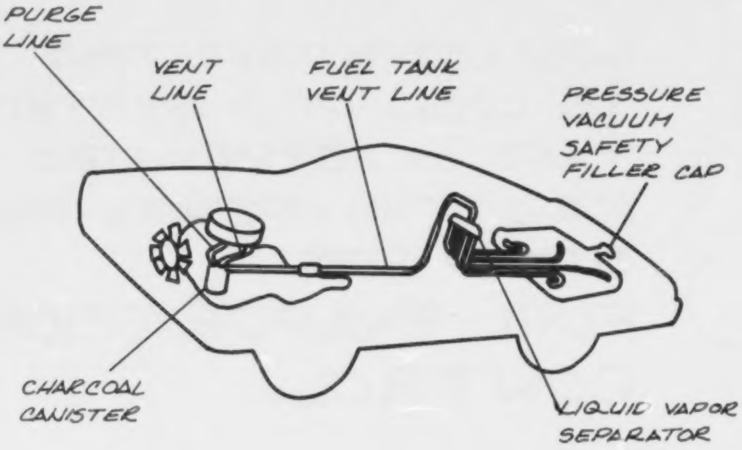
THIS JOB IS...

TO PREVENT FUEL (OR GASOLINE) VAPORS FROM GETTING OUT THE FUEL TANK OR THE CARBURETOR AND POLLUTING THE AIR. THESE GASOLINE VAPORS ARE ANOTHER SOURCE OF **HC** OR HYDROCARBON EMISSIONS AND MUST BE CONTROLLED.


HC EMISSIONS
FUEL TANK
CARBURETOR

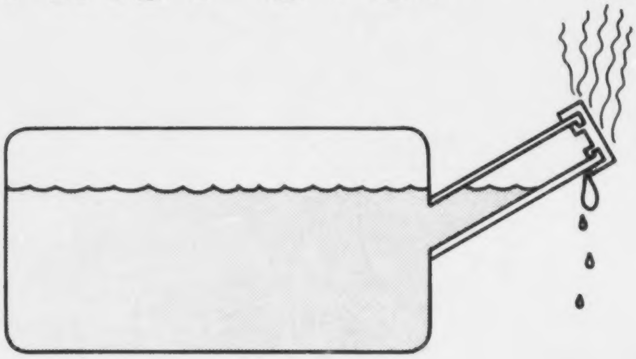


I'LL BET YOU'RE WONDERING IF YOUR CAR HAS THIS SYSTEM, RIGHT? WELL, ALL CARS BUILT FOR CALIFORNIA IN 1970 HAVE IT. ALL CARS, 1971 OR NEWER, HAVE F.E.C. SYSTEMS.


PURGE LINE
VENT LINE
FUEL TANK VENT LINE
PRESSURE VACUUM SAFETY FILLER CAP
CHARCOAL CANISTER
LIQUID VAPOR SEPARATOR

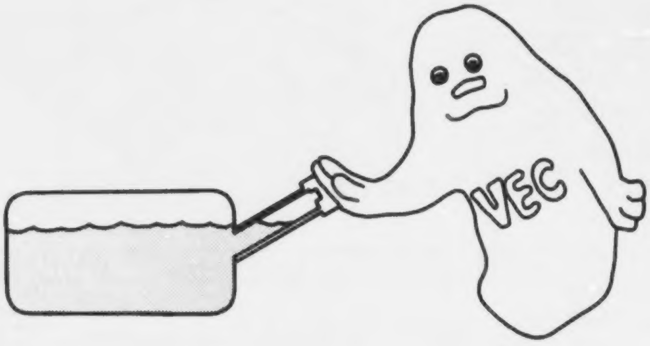
LET'S LOOK AT SOME OF THE PARTS THAT ARE COMMON TO ALL F.E.C. SYSTEMS. MANY OF THESE YOU MAY NOT BE ABLE TO FIND. I'LL EXPLAIN WHY WHEN WE GET TO THEM.

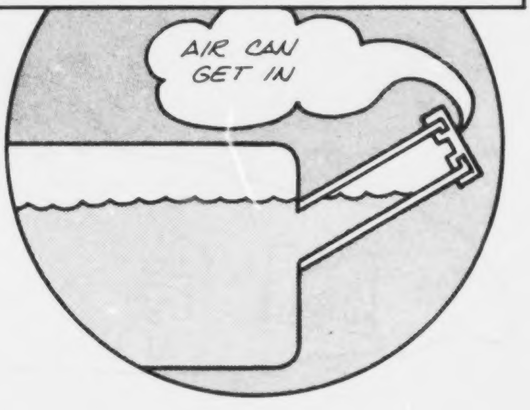
FIRST STOP - THE FUEL TANK



IN DAYS OF OLD, FUEL TANKS WERE VENTED TO ATMOSPHERE. THE CAP ALLOWED VAPORS (AND SOMETIMES EVEN LIQUID FUEL) TO ESCAPE. IT ALSO ALLOWED AIR TO BE DRAWN IN, AS THE LEVEL IN THE FUEL TANK DROPPED.

THE FUEL TANKS TODAY ARE DESIGNED TO PREVENT VAPOR LOSS TO THE ATMOSPHERE. **THE FILLER CAP** PREVENTS VAPORS FROM ESCAPING ON F.E.C. EQUIPPED CARS.

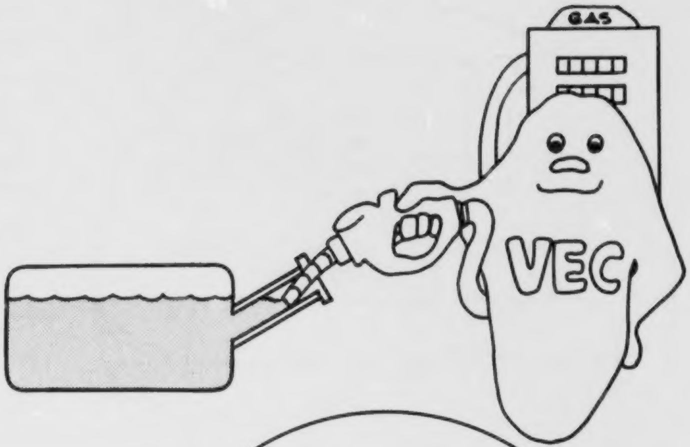


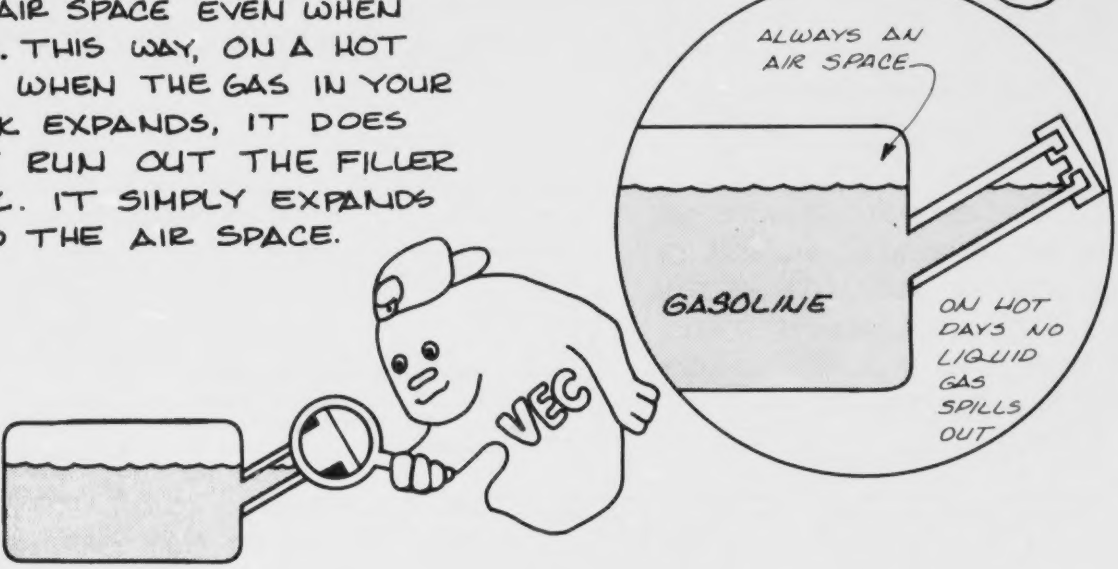

AIR CAN GET IN

THE FILLER CAP WILL ALLOW AIR **INTO** THE TANK, ONLY IF A PROBLEM DEVELOPS ELSEWHERE IN THE SYSTEM.

YOU HAVE PROBABLY NOTICED WHEN YOU FILL YOUR GAS TANK THAT YOU JUST CANNOT "TOP 'EM OFF" LIKE IN THE OLD DAYS. FUEL TANKS ARE DESIGNED SO THEY CANNOT BE COMPLETELY FILLED.

TO PREVENT LIQUID GASOLINE FROM ESCAPING, THE NEW GAS TANKS ALWAYS HAVE AN AIR SPACE EVEN WHEN FULL. THIS WAY, ON A HOT DAY, WHEN THE GAS IN YOUR TANK EXPANDS, IT DOES NOT RUN OUT THE FILLER NECK. IT SIMPLY EXPANDS INTO THE AIR SPACE.

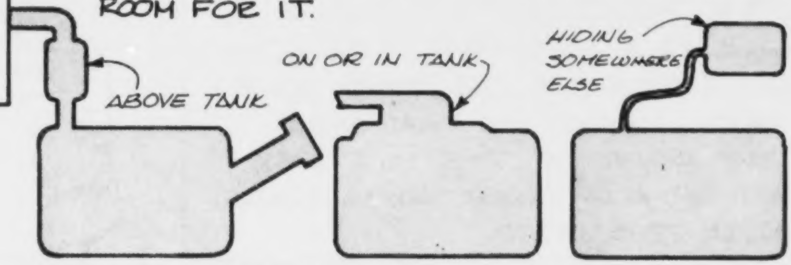



ALWAYS AN AIR SPACE
GASOLINE
ON HOT DAYS NO LIQUID GAS SPILLS OUT
VEC

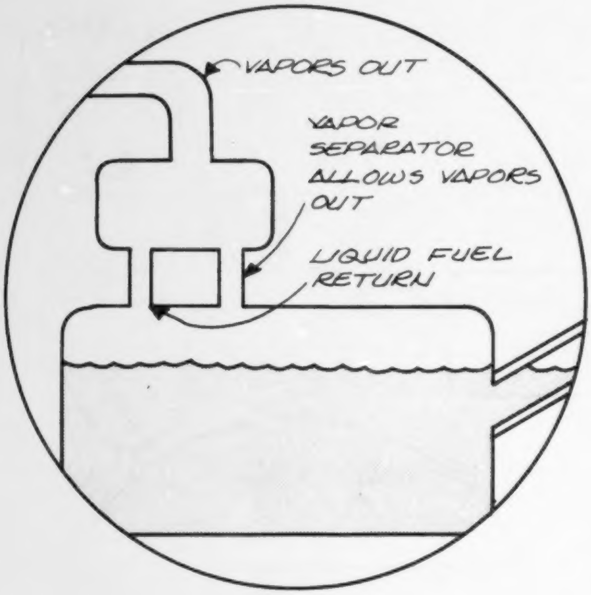
WHERE DO THE VAPORS GO ???

I THOUGHT THAT WOULD BE YOUR NEXT QUESTION. LET'S FOLLOW THESE VAPORS AS THEY LEAVE THE GAS TANK AND SEE WHAT HAPPENS TO THEM

AS THE VAPORS LEAVE THE FUEL TANK THE FIRST DEVICE THEY GO THROUGH IS A **VAPOR SEPARATOR**. THIS PART IS VERY HARD TO FIND ON MOST CARS. IT CAN BE IN THE FUEL TANK, ABOVE IT, OR OFF ALMOST ANY PLACE WHERE THERE IS ROOM FOR IT.


ABOVE TANK
ON OR IN TANK
HIDING SOMEWHERE ELSE

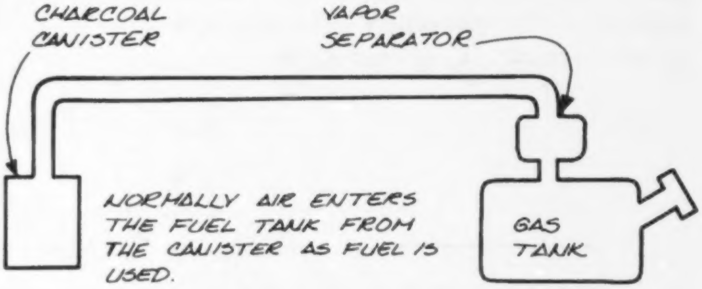
VAPOR SEPARATORS ARE TOUGH TO FIND

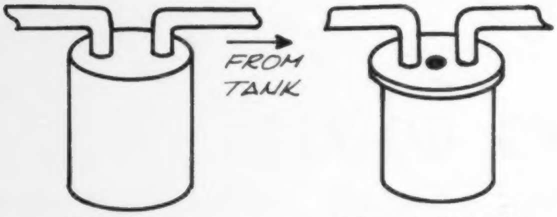

VAPORS OUT
VAPOR SEPARATOR ALLOWS VAPORS OUT
LIQUID FUEL RETURN

THE VAPOR SEPARATOR IS A VERY TROUBLE-FREE PART. IT'S PURPOSE IS TO MAKE SURE ONLY THE VAPORS ARE ALLOWED TO PASS THROUGH IT. ANY LIQUID FUEL IS RETURNED TO THE TANK.

FROM THE SEPARATOR, THE VAPORS PASS THROUGH A LINE TO THE FRONT OF YOUR CAR. THESE VAPORS ARE GOING TO A CHARCOAL CANISTER.

THE CHARCOAL CANISTER CAN BE A BLACK PLASTIC CAN OR A ROUND METAL CAN. IT WILL HAVE TWO, THREE OR FOUR HOSES ATTACHED TO IT.


CHARCOAL CANISTER
VAPOR SEPARATOR
NORMALLY AIR ENTERS THE FUEL TANK FROM THE CANISTER AS FUEL IS USED.
GAS TANK

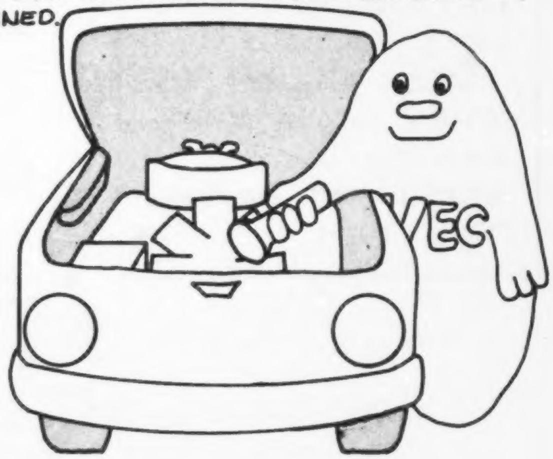


CHARCOAL CANISTER

SOME CHACOAL CANISTERS ARE MADE OF METAL & PAINTED BLUE

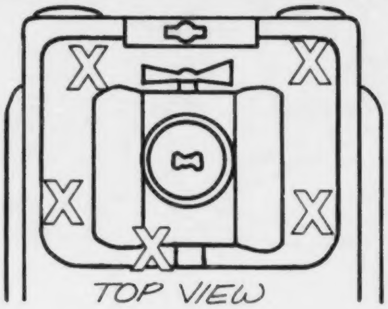
THE CHARCOAL INSIDE THE CANISTER IS USED TO STORE THE VAPORS FROM THE FUEL TANK. ON SOME CARS IT STORES THE VAPORS FROM THE CARBURETOR AS WELL. WHEN THE ENGINE IS STARTED THESE VAPORS WILL BE DRAWN INTO THE ENGINE & BURNED.

THOSE ARE THE PARTS THAT ARE COMMON TO MOST CARS WITH F.E.C. LET'S TAKE A WALK OUT AND OPEN THE HOOD AND SEE IF WE CAN FIND SOME PARTS. MAYBE WE CAN EVEN TAKE SOME OF THE MYSTERY OUT OF ALL THOSE HOSES FOUND UNDER THE HOOD.



WARNING: KEEP IN MIND → GASOLINE VAPORS ARE EXPLOSIVE.

FIRST STOP – UNDER THE HOOD

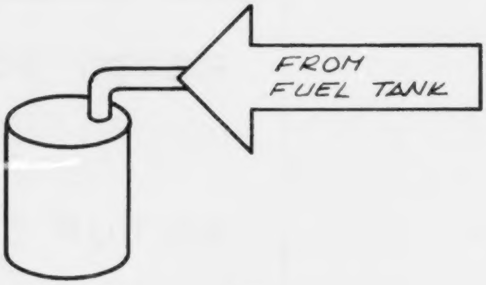


CHECK THESE AREAS FOR THE CHARCOAL CANISTER. SOME AUTO MAKERS PUT THEM ON THE FIREWALL OR OTHER PLACES AS SHOWN BY THE X'S.

THE FIRST THING WE SHOULD FIND IS THE CHARCOAL CANISTER. LOOK DOWN BY THE FRONT OF THE FENDERS, JUST BEHIND THE FRAME THAT HOLDS THE RADIATOR.

DON'T GIVE UP ~ IT'S UNDER THERE SOMEWHERE!

NOW THAT YOU'VE FOUND IT, LOOK AT THE HOSES ATTACHED TO IT.



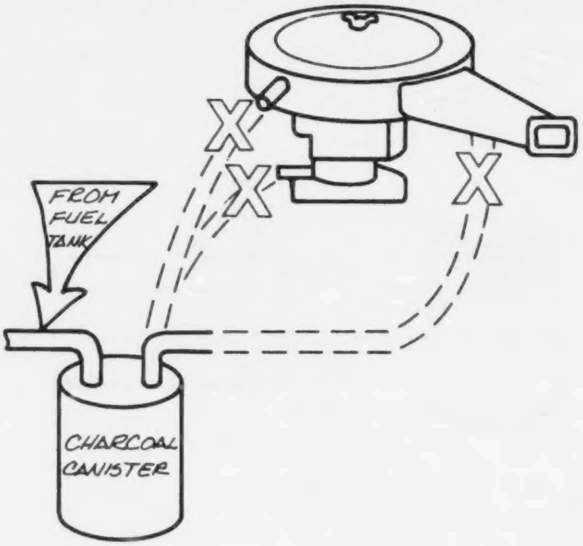
ONE HOSE SHOULD BE COMING FROM THE BACK OF YOUR CAR – THAT'S RIGHT – FROM THE FUEL TANK. THIS HOSE IS COMMON TO ALL F.E.C. SYSTEMS.

IF THERE ARE ONLY **TWO** HOSES ATTACHED TO THE CANISTER FOLLOW THE HOSE NOT GOING TO THE FUEL TANK. IT WILL LEAD TO EITHER:

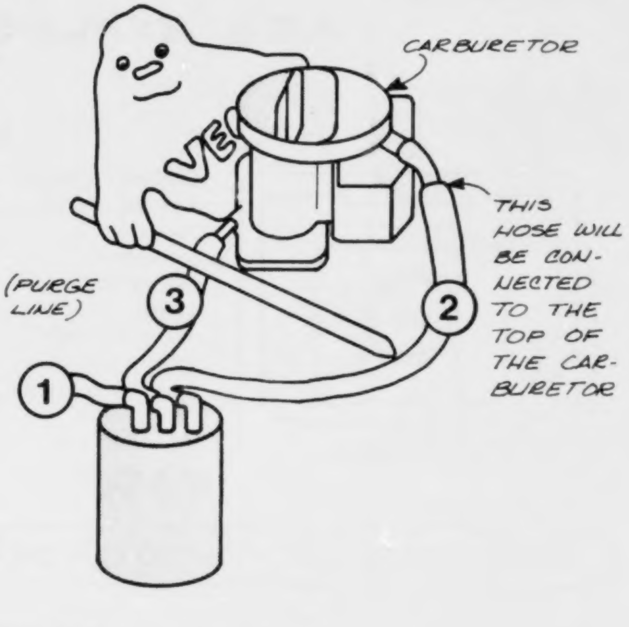
a. THE AIR CLEANER, OR
b. THE BOTTOM OF THE CARBURETOR.

THIS HOSE IS FOR TAKING THE VAPORS OUT OF THE CANISTER AND PUTTING THEM BACK INTO THE ENGINE TO BE BURNED. THIS HOSE IS CALLED A **"PURGE"** LINE. THERE WILL BE A PURGE LINE ON ALL F.E.C. SYSTEMS.

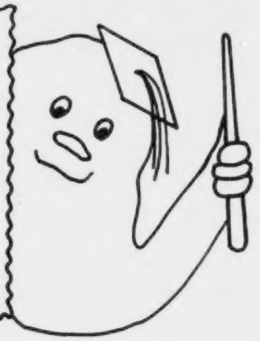
THE OTHER HOSE CAN BE CONNECTED TO ANY ONE OF THESE PLACES. JUST DEPENDS ON WHO BUILT THE CAR.



IF THERE ARE **THREE** HOSES COMING FROM THE CANISTER: **1st** – FIND THE ONE THAT COMES FROM THE FUEL TANK. (THIS HOSE IS COMMON TO ALL CANISTER HOOKUPS.) **2nd** – TRACE THE SECOND HOSE UP TO THE CARBURETOR LIKE I'M SHOWING YOU HERE. THIS HOSE ALLOWS THE VAPORS FROM THE CARBURETOR TO BE VENTED INTO THE CHARCOAL CANISTER. THE **3rd** HOSE IS FOR REMOVAL OF THE VAPORS IN THE CHARCOAL CANISTER – THE "PURGE" HOSE.

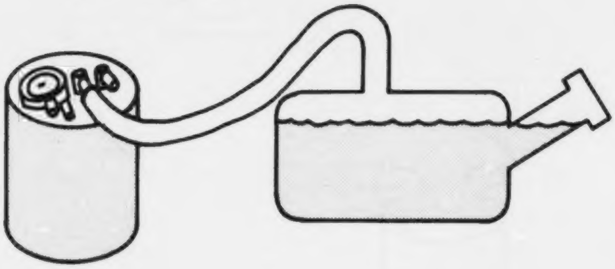

CARBURETOR
VE
THIS HOSE WILL BE CONNECTED TO THE TOP OF THE CARBURETOR
(PURGE LINE)
3
2
1

READY FOR THE FOUR HOSE SETUP?

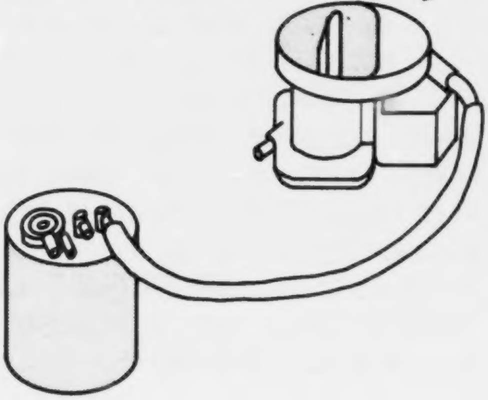


FIRST, LET'S FIND THE HOSES WE'VE ALREADY TALKED ABOUT.

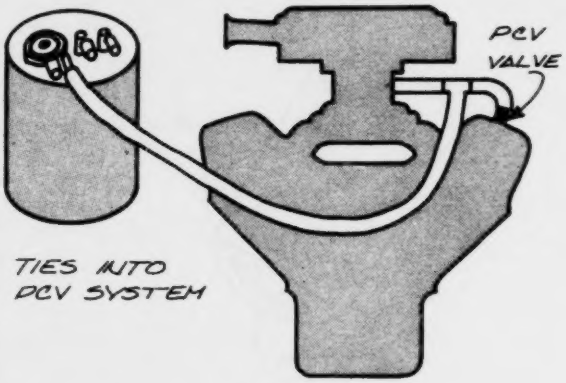
① TRACE THE HOSE FROM THE FUEL TANK TO THE CANISTER.



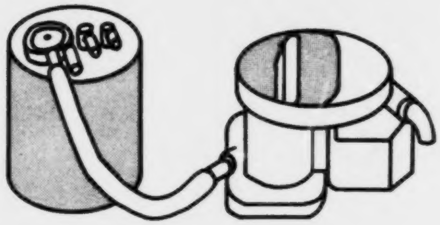
② NEXT TRACE THE HOSE FROM THE CARBURETOR (THE ONE THAT LETS CARBURETOR VAPORS INTO THE CANISTER.)



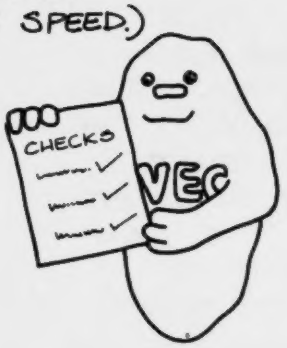
③ IF YOU TRACE THIS LINE YOU WILL SEE THAT IT TIES INTO THE PCV LINE. THIS IS THE PURGE LINE. THE ONLY DIFFERENCE WITH THIS ONE IS WHERE IT IS ATTACHED. THIS SETUP ALLOWS A SMALL AMOUNT OF VAPORS TO BE TAKEN OUT OF THE CANISTER ANY TIME THE ENGINE IS IDLING.



④ TRACE THIS LINE UP TO THE CARBURETOR. THIS LINE IS ACTUALLY A VACUUM SIGNAL LINE. IT TELLS A VALVE ON THE CANISTER WHEN YOU STEP ON THE ACCELERATOR. (MORE VAPORS ARE PURGED WHEN YOU INCREASE ENGINE SPEED.)



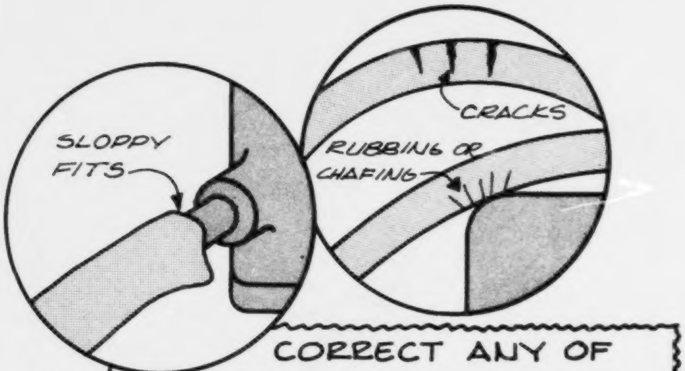
I HOPE THAT TAKES SOME OF THE MYSTERY OUT OF THE F.E.C. SYSTEM AND IT'S HOSES.



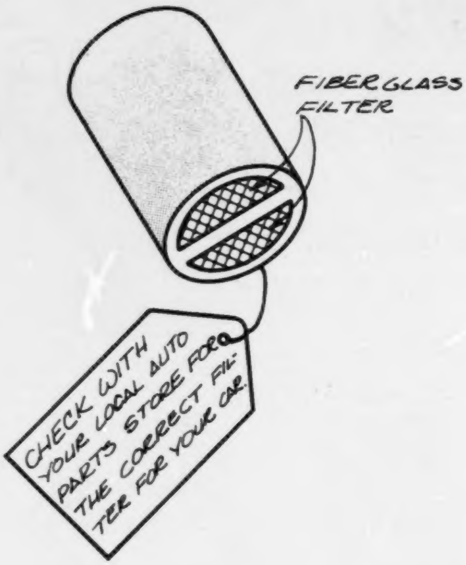
NOW I'D LIKE TO SHOW YOU SOME CHECKS YOU CAN MAKE ON THE F.E.C. SYSTEM.

FIRST THING TO LOOK AT IS ALL THE HOSES WE HAVE BEEN TALKING ABOUT. CHECK THESE FOR THE FOLLOWING CONDITIONS:

1. - SLOPPY FITS
2. - CRACKS
3. - HARD AND BRITTLE
4. - RUB MARKS WHERE THEY MAY WEAR THROUGH.



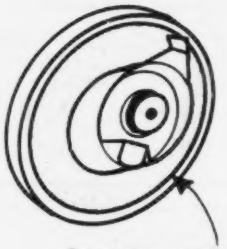
CORRECT ANY OF THESE CONDITIONS THAT YOU FIND. ONE OF THE BIGGEST TROUBLE MAKERS WITH EMISSION CONTROL SYSTEMS IS BAD HOSE CONNECTIONS.


FIBERGLASS FILTER
CHECK WITH YOUR LOCAL AUTO PARTS STORE FOR THE CORRECT FILTER FOR YOUR CAR.

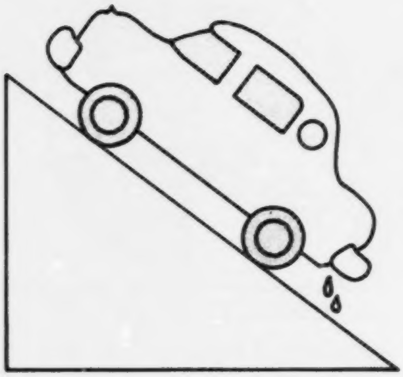
IF YOUR CAR HAS THE BLACK PLASTIC CANISTER THERE IS PROBABLY A **FILTER** ON THE BOTTOM OF IT. REACH UNDER AND SEE IF YOU CAN FEEL A FIBERGLASS FILTER. THIS SHOULD BE REPLACED ABOUT EVERY 15,000 MILES. THIS FILTER CLEANS THE AIR THAT IS USED TO "PURGE" THE FUEL VAPORS FROM THE CANISTER, AND IT IS USUALLY FILTHY.

IF YOUR CANISTER IS METAL, THERE IS NO FILTER FOR YOU TO WORRY ABOUT.

ONE OTHER ITEM YOU MIGHT WANT TO CHECK IS THE GAS TANK FILLER CAP. REMOVE THE **FILLER CAP** AND LOOK AT THE **RUBBER GASKET.** THAT GASKET MAKES A TIGHT SEAL BETWEEN THE CAP AND THE GAS TANK FILLER NECK. IF IT IS CRACKED OR A CHUNK OF THE GASKET IS MISSING, REPLACE THE CAP.

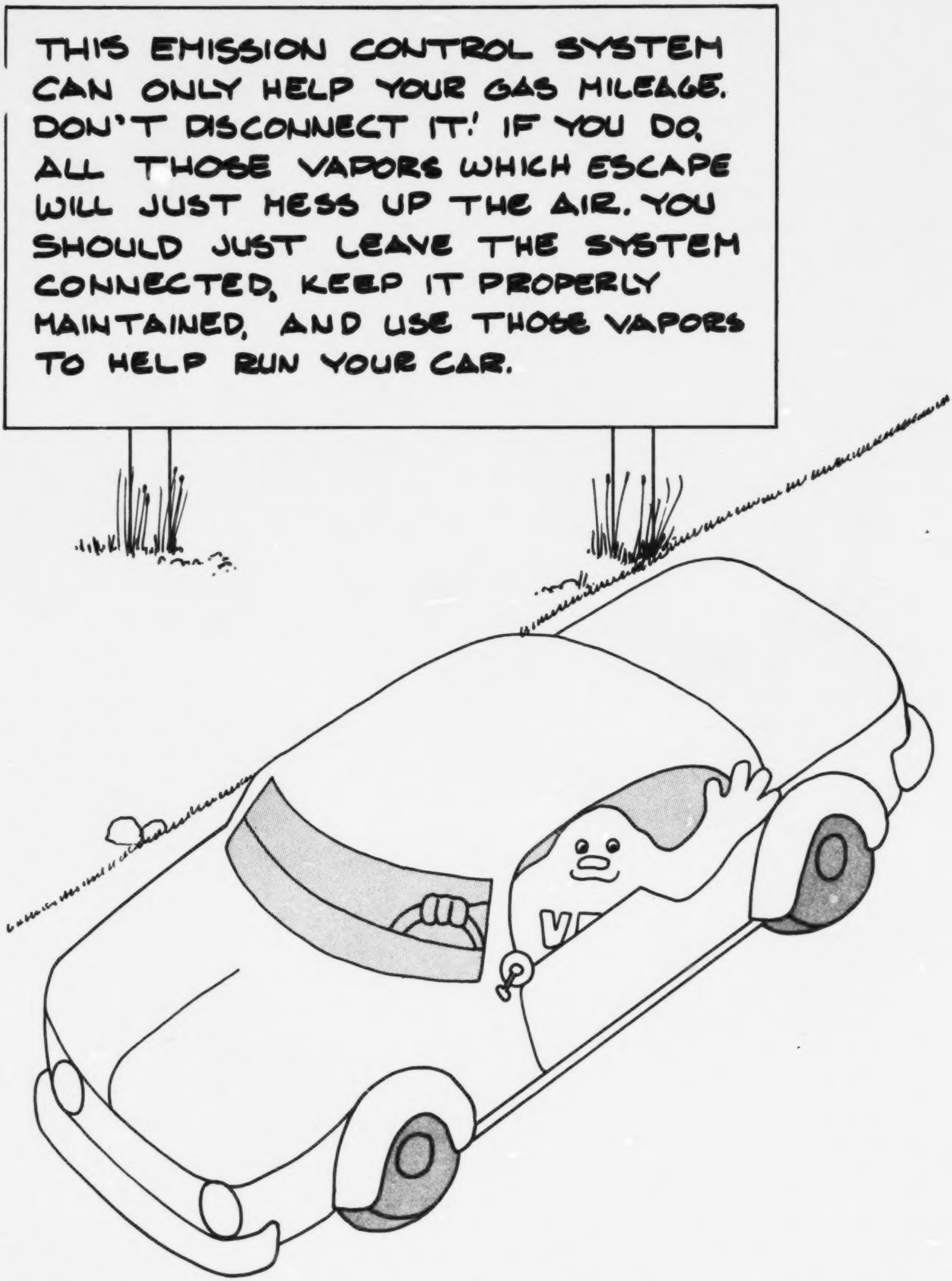


CHECK THE GASKET
REPLACE CAP IF GASKET IS DAMAGED.



IF YOU PARK YOUR CAR FACING UPHILL AND YOU SEE GAS RUNNING OUT, AGAIN, REPLACE THE CAP.

MAKE SURE YOU GET THE PROPER CAP FOR YOUR CAR.



THIS EMISSION CONTROL SYSTEM CAN ONLY HELP YOUR GAS MILEAGE. DON'T DISCONNECT IT! IF YOU DO, ALL THOSE VAPORS WHICH ESCAPE WILL JUST MESS UP THE AIR. YOU SHOULD JUST LEAVE THE SYSTEM CONNECTED, KEEP IT PROPERLY MAINTAINED, AND USE THOSE VAPORS TO HELP RUN YOUR CAR.

EXHAUST GAS
RECIRCULATION SYSTEMS

Preceding page blank

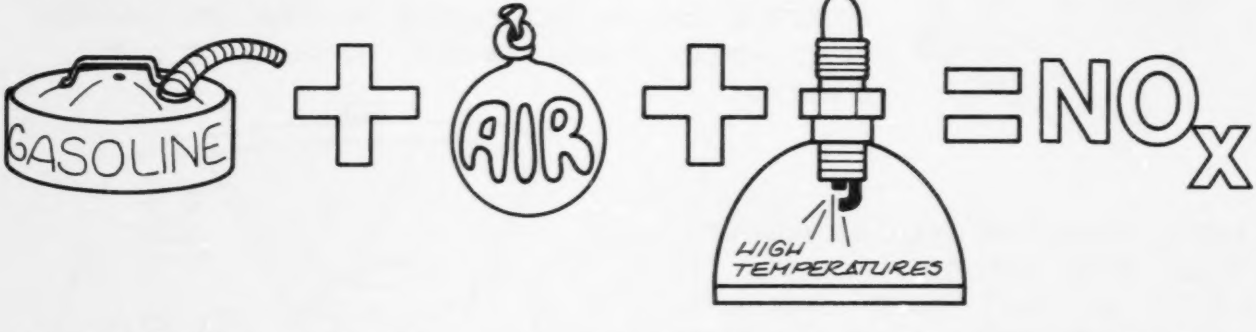
EGR=
EXHAUST
GAS
RECIRCULATION

IT IS TIME TO LOOK AT THE SYSTEM THAT IS ABBREVIATED E.G.R. THE LETTERS STAND FOR

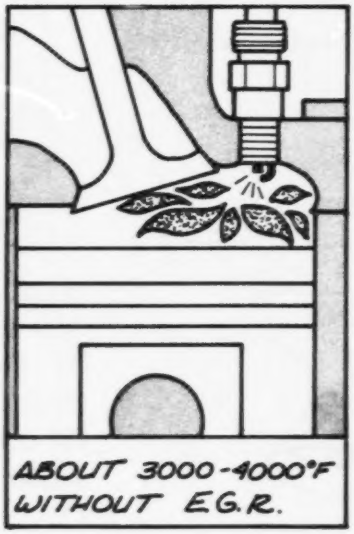
EXHAUST GAS RECIRCULATION.

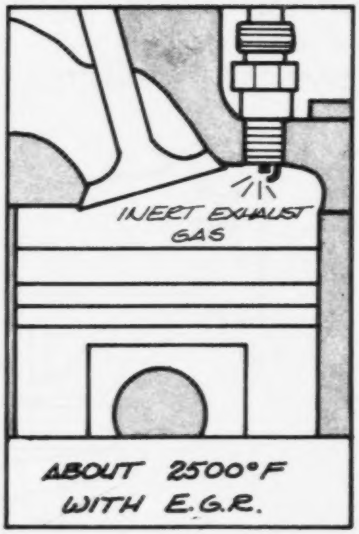
WAY BACK IN THE FRONT OF THIS BOOK I MENTIONED A NASTY POLLUTANT CALLED **NO_x**. REMEMBER?

NO_x IS THE STUFF THAT RESULTS WHEN AIR AND FUEL BURN. THE HOTTER THE AIR-FUEL MIXTURE BURNS, THE MORE NO_x IS PRODUCED.


GASOLINE
+
AIR
+
HIGH TEMPERATURES
= NOX

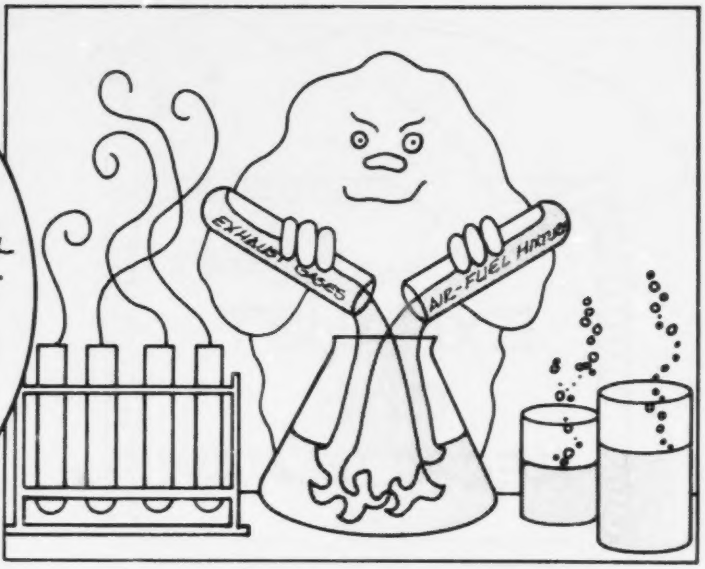
THE PURPOSE OF THE EGR SYSTEM IS TO LOWER THE TEMPERATURE WHEN THE AIR-FUEL MIXTURE BURNS. THIS REDUCES THE AMOUNT OF NO_x FORMED, WHICH IN TURN GIVES US CLEANER AIR TO BREATH.


ABOUT 3000-4000°F
WITHOUT E.G.R.


INERT EXHAUST GAS
ABOUT 2500°F
WITH E.G.R.

Preceding page blank

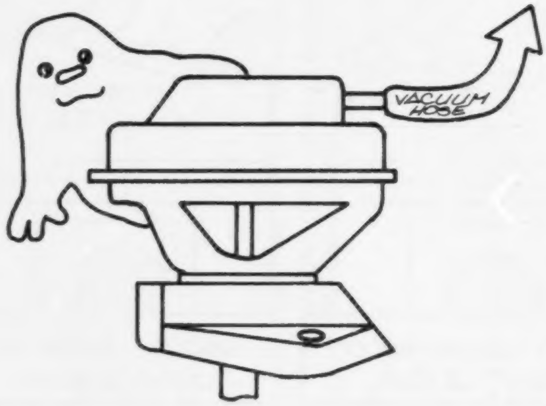
THE E.G.R. SYSTEM REDUCES THE AMOUNT OF NO_x PRODUCED BY MIXING A SMALL AMOUNT OF BURNED EXHAUST GAS WITH THE FRESH AIR/FUEL MIXTURE IN THE INTAKE MANIFOLD. JUST ENOUGH EXHAUST GAS IS ADDED TO LOWER NO_x TO THE LEVEL REQUIRED BY THE ENVIRONMENTAL PROTECTION AGENCY.


EXHAUST GASES
AIR-FUEL MIXTURE

DAILY BLAT
CALIFORNIA LEADS THE WAY IN AUTO EMISSION CONTROL

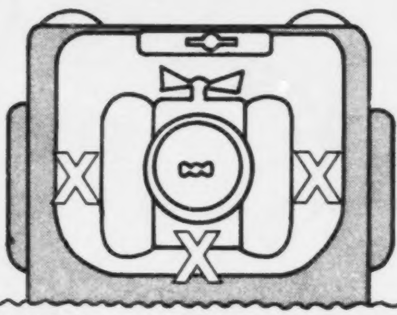
E.G.R. WAS FIRST USED ON CALIFORNIA CARS IN 1972. IN 1973, AND EVER SINCE, E.G.R. HAS BEEN USED ON NEARLY EVERY CAR MADE IN THE UNITED STATES. E.G.R. IS ALSO USED ON MOST FOREIGN CARS SOLD IN THE UNITED STATES. SO IF YOUR CAR IS 1973 OR NEWER, YOU MORE THAN LIKELY HAVE AN E.G.R. SYSTEM.

NOW THAT WE KNOW WHAT THE EGR SYSTEM DOES, LETS GO OUT AND CHECK UNDER THE HOOD AND SEE IF WE CAN FIND SOME EGR SYSTEM PARTS.


VACUUM HOSE

THE FIRST PART WE WANT TO FIND IS THE E.G.R. VALVE. IT LOOKS VERY SIMILAR TO THE ONE I'M SHOWING YOU HERE. IT WILL ALSO HAVE A VACUUM HOSE COMING FROM THE TOP OF IT.

TOP VIEW



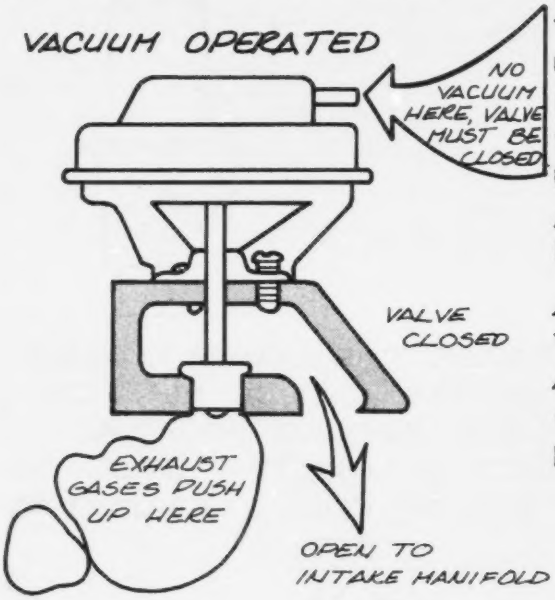
CHECK THESE LOCATIONS FOR THE EGR VALVE ON A V-8 ENGINE.

THIS E.G.R. VALVE WILL NORMALLY BE LOCATED ON THE INTAKE MANIFOLD. IT MAY BE ON THE LEFT OR RIGHT OF THE CARBURETOR OR BEHIND IT.

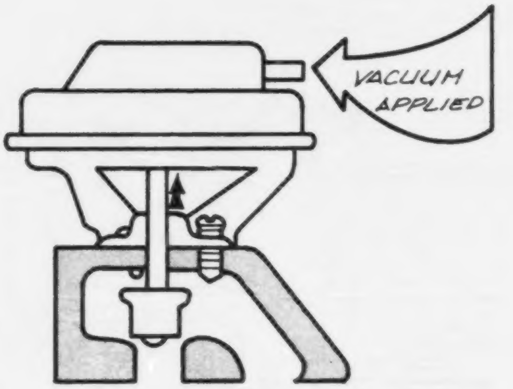
IF YOUR CAR HAS A 6 CYLINDER ENGINE THE EGR VALVE SHOULD BE LOCATED FAIRLY CLOSE TO THE CARBURETOR.

NOW, LET ME SHOW YOU WHAT THAT VALVE LOOKS LIKE INSIDE WHEN THE EGR VALVE IS CLOSED AS SHOWN, IT PREVENTS EXHAUST GASES FROM ENTERING THE INTAKE MANIFOLD AND MIXING WITH THE AIR-FUEL MIXTURE.

VACUUM OPERATED


NO VACUUM HERE, VALVE MUST BE CLOSED
VALVE CLOSED
EXHAUST GASES PUSH UP HERE
OPEN TO INTAKE MANIFOLD

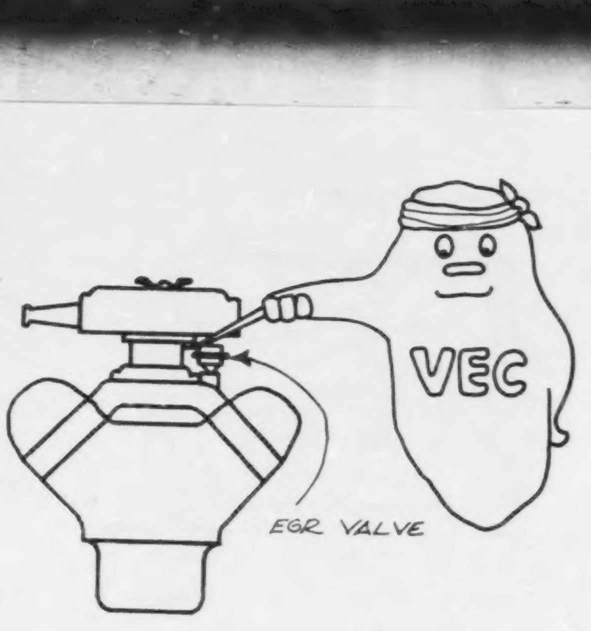
AS VACUUM IS APPLIED, THE EGR VALVE STARTS TO OPEN. THIS ALLOWS THE BURNED EXHAUST GAS TO MIX WITH THE AIR-FUEL MIXTURE IN THE INTAKE MANIFOLD


VACUUM APPLIED

VALVE BEGINS TO OPEN

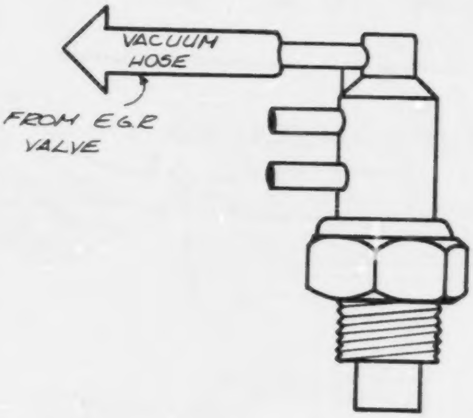
NOW THAT WE KNOW WHAT IT LOOKS LIKE ON THE INSIDE. LETS GO A LITTLE FARTHER AND SEE IF WE CAN MAKE SOME SENSE OUT OF SOME OTHER ITEMS FOUND ON EGR SYSTEMS.

NOW FOLLOW THE VACUUM HOSE FROM THE EGR VALVE TO THE OTHER END. ON SOME CARS IT WILL SIMPLY GO TO THE BOTTOM OF THE CARBURETOR LIKE I'M SHOWING YOU HERE.

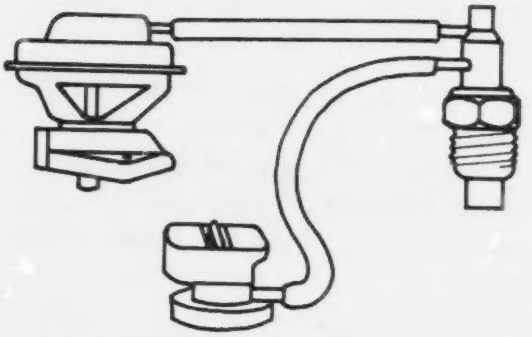


OR

THE HOSE FROM THE EGR VALVE MAY ATTACH TO A DEVICE LIKE THIS. THIS DEVICE IS CALLED A **C. T. O. SWITCH.**

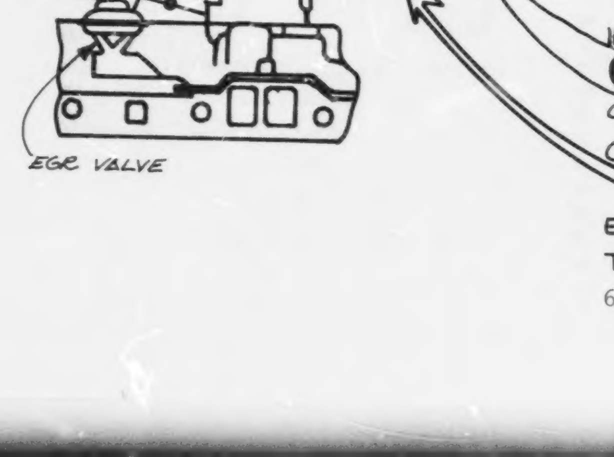


C. T. O. STANDS FOR COOLANT TEMPERATURE OVERRIDE.



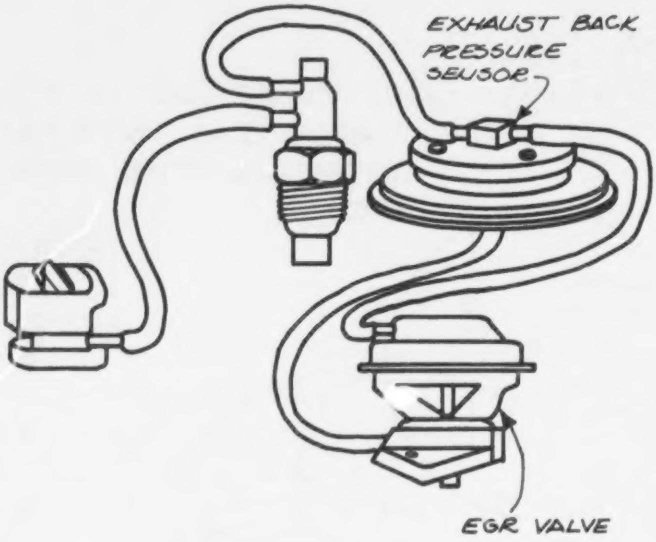
NOW TRACE THE LOWER VACUUM HOSE ON THE C. T. O. SWITCH. THIS HOSE SHOULD GO TO A CONNECTION ON THE BASE, OR BOTTOM, OF THE CARBURETOR

OR



IT MAY GO TO A DEVICE LIKE THIS. THIS DEVICE IS CALLED A **"VACUUM AMPLIFIER."** IF YOU HAVE ONE OF THESE ON YOUR CAR TAKE A SECOND AND TRACE THE OTHER VACUUM HOSES COMING FROM THE VACUUM AMPLIFIER. **ONE VACUUM HOSE** SHOULD GO FROM THE AMPLIFIER TO THE CARBURETOR. **THE OTHER ONE** SHOULD BE CONNECTED TO AN INTAKE MANIFOLD TAP ON THE INTAKE MANIFOLD.

LET'S LOOK AT ONE OTHER EGR SYSTEM THAT IS FAIRLY COMMON.

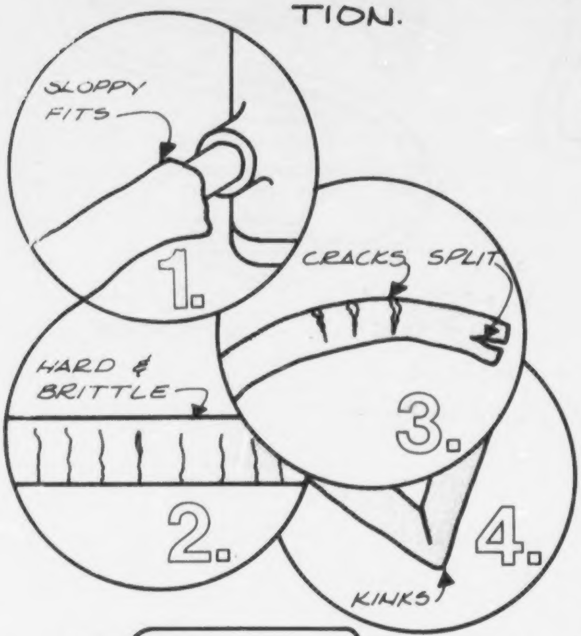

EXHAUST BACK PRESSURE SENSOR
EGR VALVE

IF YOU HAVE A SYSTEM LIKE THIS ON YOUR CAR YOU WILL RECOGNIZE SOME OF THE PARTS WE HAVE ALREADY TALKED ABOUT, NAMELY THE EGR VALVE AND THE CTO SWITCH. THE OTHER STRANGE LOOKING PIECE IS CALLED AN **EXHAUST BACK PRESSURE SENSOR.**

A WORD OF CAUTION

THERE ARE MANY DIFFERENCES IN EGR SYSTEMS. IF THE ONE ON YOUR CAR HAS MORE PARTS, OR PARTS THAT ARE DIFFERENT FROM THE ONES I'VE SHOWN YOU, GET A SERVICE MANUAL FOR YOUR PARTICULAR CAR.

O.K. NOW THAT WE'VE FOUND THE MAIN PARTS OF THE E.G.R. SYSTEM, LET'S SEE ABOUT CHECKING THE SYSTEM FOR PROPER OPERATION.

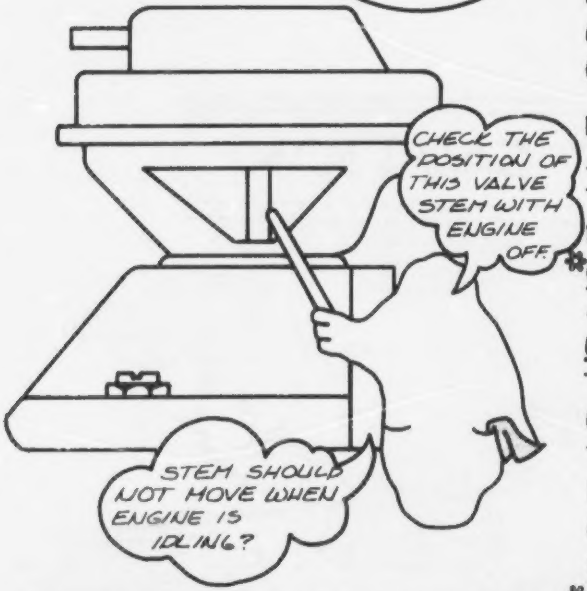

SLOPPY FITS
1.
CRACKS SPLIT
3.
HARD & BRITTLE
2.
4.
KINKS

FIRST - CHECK ALL VACUUM HOSES FOR THE FOLLOWING:

1. - LOOSE FITS OR SLOPPY CONNECTIONS.
2. - HOSES THAT ARE HARD AND BRITTLE.
3. - HOSES THAT ARE SPLIT OR CRACKED.
4. - HOSES THAT ARE KINKED.

REPLACE ALL HOSES THAT ARE IN BAD CONDITION.

NOW, LET'S GET BACK TO CHECKING THE SYSTEM OPERATION.


CHECK THE POSITION OF THIS VALVE STEM WITH ENGINE OFF.
STEM SHOULD NOT MOVE WHEN ENGINE IS IDLING?

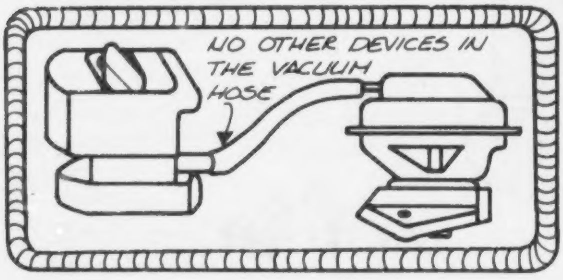
LET ME START BY SAYING THAT WHEN THE ENGINE IS IDLING, THE E.G.R. VALVE SHOULD BE CLOSED.

FIRST, CHECK THIS BY LOOKING AT AND MARKING THE POSITION OF THE E.G.R. VALVE STEM WITH THE ENGINE SHUT OFF.

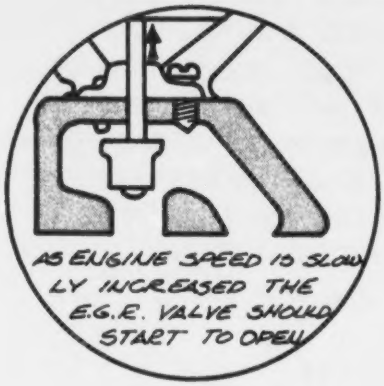
WARNING: AGAIN, MAKE SURE THE AREA YOU ARE WORKING IN IS WELL VENTILATED.

THEN HAVE A FRIEND START YOUR ENGINE AND LET IT IDLE. WATCH THAT VALVE STEM. IT SHOULD BE IN THE SAME POSITION THAT IT WAS IN WHEN THE ENGINE WAS SHUT OFF.

CAUTION: KEEP HANDS CLEAR OF BELTS, FAN BLADES, AND OTHER MOVING PARTS.


NO OTHER DEVICES IN THE VACUUM HOSE

IF THERE IS ONLY A SHORT PIECE OF VACUUM HOSE RUNNING FROM THE E.G.R. VALVE TO THE BOTTOM OF THE CARBURETOR - TAKE THE FOLLOWING STEPS.......

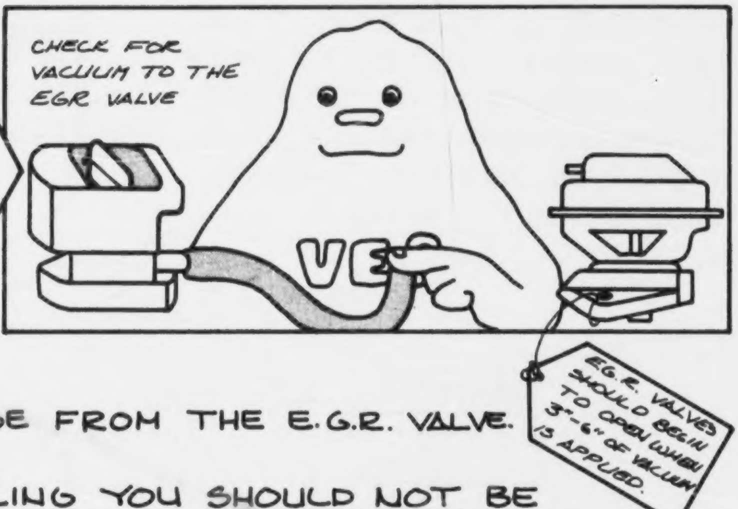

AS ENGINE SPEED IS SLOWLY INCREASED THE E.G.R. VALVE SHOULD START TO OPEN

1. KEEP AN EYE ON THAT EGR VALVE STEM.
2. SLOWLY – START INCREASING THE SPEED OF THE ENGINE. THE VALVE STEM SHOULD START TO MOVE UP AS ENGINE SPEED INCREASES. IF IT DOES, THE SYSTEM IS WORKING O.K.

CAUTION

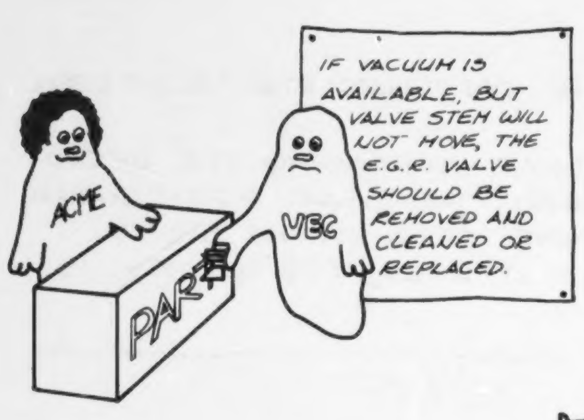
DON'T OVERSPEED THE ENGINE. IF YOU HAVE A TACHOMETER AVAILABLE USE IT. YOU SHOULDN'T HAVE TO EXCEED 2500 R.P.M.

IF IT DOESN'T OPEN WHEN YOU INCREASE ENGINE SPEED, CHECK TO SEE IF YOU HAVE VACUUM TO THE E.G.R. VALVE.


CHECK FOR VACUUM TO THE EGR VALVE
VE
E.G.R. VALVES SHOULD BEGIN TO OPEN WHEN 3"-6" OF VACUUM IS APPLIED.

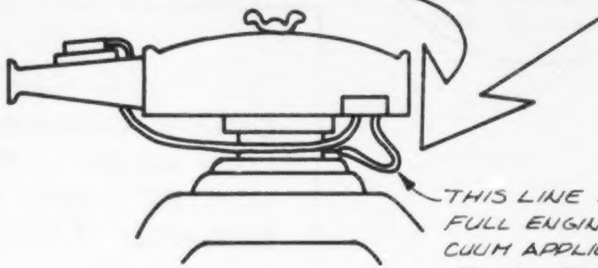
1. DISCONNECT THE HOSE FROM THE E.G.R. VALVE.
2. WITH THE ENGINE IDLING YOU SHOULD NOT BE ABLE TO FEEL ANY VACUUM AT THE OF THE HOSE.
3. SLOWLY START INCREASING ENGINE SPEED.
4. BEFORE THE ENGINE REACHES 2500 R.P.M. YOU SHOULD FEEL A VACUUM AT THE END OF THE HOSE. IF NOT – CHECK FOR A PLUGGED PASSAGE OR A BLOCKED HOSE. CORRECT AS NECESSARY. IF VACUUM IS AVAILABLE, AND THE VALVE IS NOT WORKING, YOUR EGR. VALVE WILL HAVE TO BE CLEANED OR REPLACED. HOWEVER, READ ON BEFORE YOU REPLACE IT!

MORE →



IF VACUUM IS AVAILABLE, BUT VALVE STEM WILL NOT MOVE, THE E.G.R. VALVE SHOULD BE REMOVED AND CLEANED OR REPLACED.

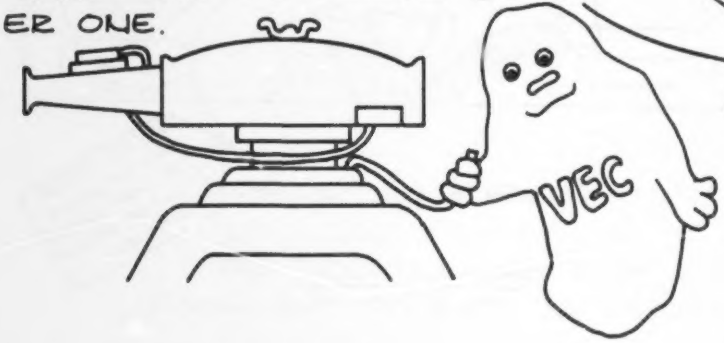
ANOTHER QUICK CHECK IS TO APPLY ANOTHER SOURCE OF VACUUM TO THE E.G.R. VALVE. IF YOU HAVE A VACUUM OPERATED THERMOSTATIC AIR CLEANER YOU HAVE A HANDY SOURCE OF VACUUM. REMEMBER THE SYSTEM? (REVIEW T.A.C. SECTION IF IN DOUBT.)



THIS LINE HAS FULL ENGINE VACCUUM APPLIED TO IT ANY TIME THE ENGINE IS RUNNING.

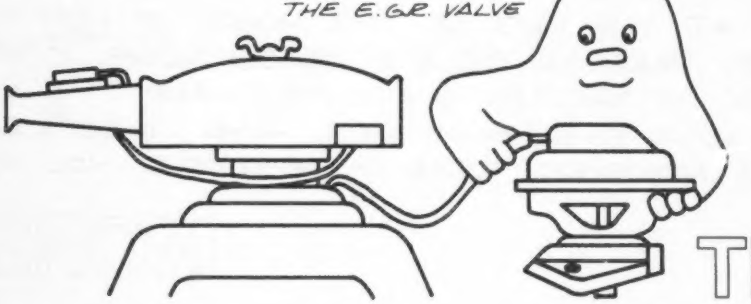
WITH YOUR ENGINE IDLING, DISCONNECT THE LINE THAT RUNS FROM THE BOTTOM OF THE CARBURETOR TO THE TEMPERATURE SENSOR. IF THIS HOSE IS TOO SHORT, TAKE TIME TO FIND A LONGER ONE.

CAUTION: BE SURE TO MARK AND MAKE SURE ALL VACUUM HOSES ARE PROPERLY REINSTALLED.



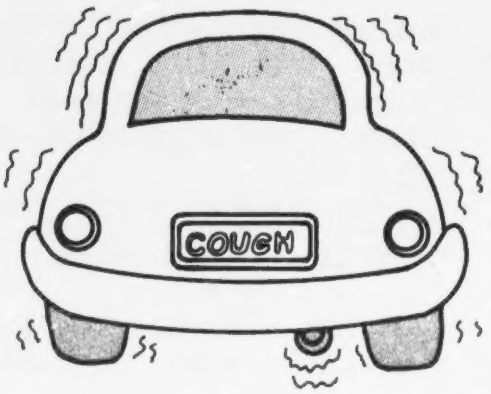
NEXT: TAKE THE HOSE AND CONNECT IT TO THE E.G.R. VALVE VACUUM LINE CONNECTION LIKE I'M SHOWING YOU HERE.

SLIP THE END OF THE HOSE OVER THE VACUUM FITTING ON THE E.G.R. VALVE



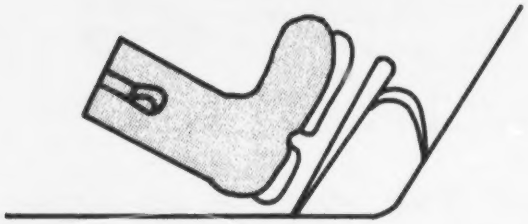
THEN...

IF "OLE JESSIE" BEGINS TO SHAKE, RATTLE, COUGHS AND MAYBE DIES ON YOU, YOU KNOW THE E.G.R. VALVE IS WORKING.



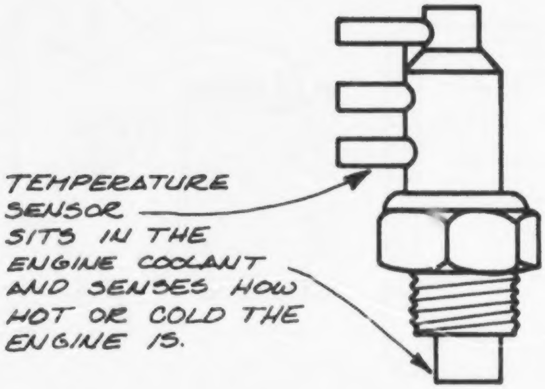
MOST E.G.R. VALVES CAN BE CHECKED IN THIS MANNER.

THIS IS ALSO A GOOD INDICATION OF WHY THE E.G.R. SYSTEM IS **NOT** SUPPOSED TO OPERATE AT IDLE.



REMEMBER THE CTO SWITCH WE TALKED ABOUT? THE PURPOSE OF THE CTO SWITCH IS:

TO PREVENT VACUUM FROM REACHING THE E.G.R. VALVE WHEN THE ENGINE IS COLD. THESE LITTLE GOODIES ARE PUT INTO SYSTEMS TO IMPROVE THE WAY OLE JESSIE RUNS WHEN SHE'S COLD.


TEMPERATURE SENSOR SITS IN THE ENGINE COOLANT AND SENSES HOW HOT OR COLD THE ENGINE IS.

THE C.T.O. SWITCH IS AN ON-OFF SWITCH! LET'S CHECK IT AND SEE IF IT IS WORKING RIGHT.

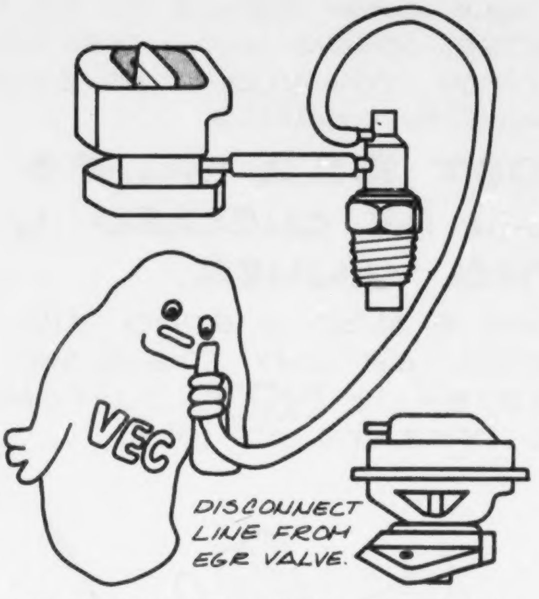
1. START WITH A COLD ENGINE.

ENGINE MUST BE COLD

2. ☐ DISCONNECT THE VACUUM FROM THE E.G.R. VALVE. THEN HAVE A FRIEND START YOUR ENGINE FOR YOU.
NOTE: MAKE SURE AREA IS WELL VENTILATED.

3. ☐ SLOWLY INCREASE THE ENGINE SPEED TO ABOUT 2000 - 2500 R.P.M.

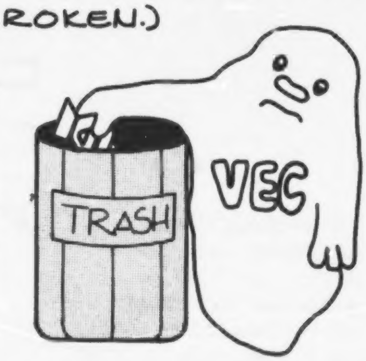
4. ☐ YOU SHOULDN'T FEEL ANY VACUUM AT THE END OF THE HOSE YOU REMOVED FROM THE E.G.R. VALVE.


VEC
DISCONNECT LINE FROM EGR VALVE.

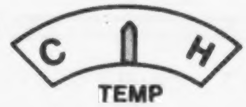
NO VACUUM AT ABOUT 2000 R.P.M. C.T.O. SWITCH IS O.K. SO FAR.

IF YOU DO FEEL VACUUM, AND THE ENGINE IS COLD (50° -60° F) BETTER THINK ABOUT REPACING THE CTO SWITCH. IT IS DEFECTIVE. (BROKEN.)

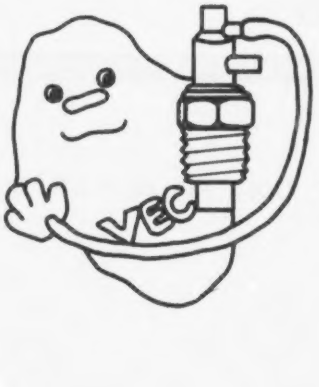
IF THE E.G.R. VALVE IS OPERATING WHEN THE ENGINE IS COLD, YOU COULD HAVE A ROUGH RUNNING CAR. CHANCES ARE WHEN THE ENGINE WARMS UP, YOU WON'T BE ABLE TO FEEL ANY ROUGHNESS.



NOW LET THE ENGINE WARM UP.

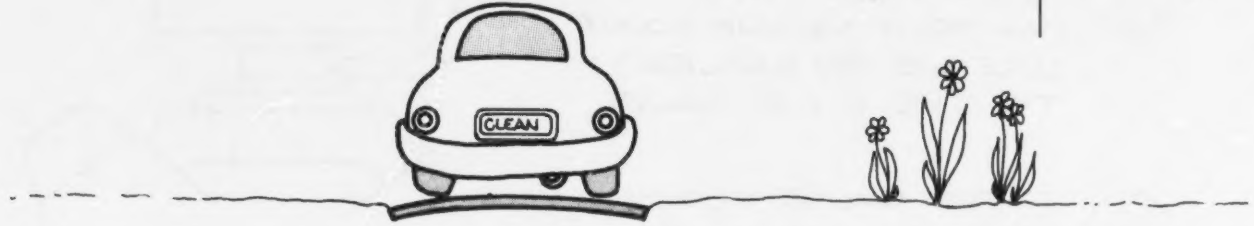


WHEN THE ENGINE REACHES OPERATING TEMPERATURE, AGAIN SLOWLY INGREASE ENGINE SPEED TO 2000 - 2500 R.P.M. NOW YOU SHOULD BE ABLE TO FEEL SOME VACUUM ON THAT LINE TO THE E.G.R. VALVE.



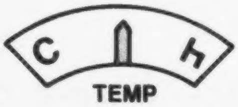
YOU SHOULD HAVE VACUUM TO THE EG.R. VALVE WHEN THE ENGINE IS WARM.

IF NO VACUUM IS FELT, REPLACE C.T.O. SWITCH WITH A NEW ONE, AND HELP REDUCE AIR POLLUTION. THAT WASN'T TOO HARD, WAS IT?



LET'S SEE HOW WE CAN CHECK OUT THE VACUUM AMPLIFIER E.G.R. SYSTEM.

1. ☐ START YOUR ENGINE AND LET IT WARM UP TO OPERATING TEMPERATURE.



2. ☐ WATCH THE E.G.R. VALVE STEM WHILE YOU QUICKLY INCREASE ENGINE SPEED TO ABOUT 2500 R.P.M.
EASY DOES IT!
DON'T OVERSPEED THE ENGINE.

3. ☐ IF THE E.G.R. VALVE STEM MOVES, THE SYSTEM IS OPERATING SATISFACTORILY.

4. ☐ TAKE THE REST OF THE DAY OFF.

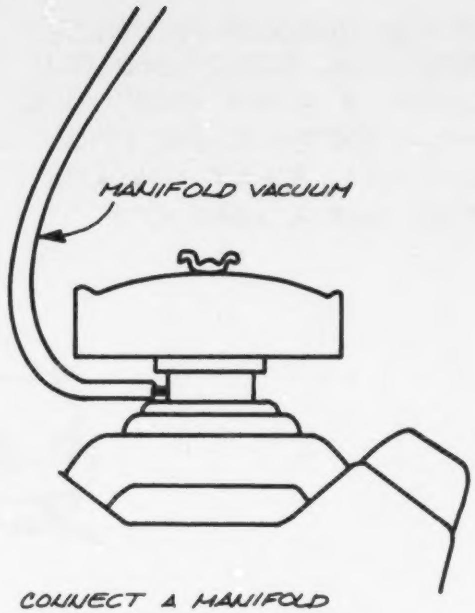
ALSO - TRY 1, 2, & 3 WITH THE ENGINE COLD. IF THE E.G.R. VALVE OPERATES, REPLACE THE C.T.O. SWITCH. THE E.G.R. SYSTEM SHOULD NOT OPERATE WITH A COLD ENGINE.

IF THE EGR VALVE STEM DOESN'T MOVE, TAKE THE FOLLOWING STEPS:

① REMOVE THE VACUUM HOSE FROM THE E.G.R. VALVE.

② WITH THE ENGINE IDLING, RUN A HOSE FROM A MANIFOLD VACUUM SOURCE (LIKE WE DID EARLIER) TO THE E.G.R. VALVE.

③ IF THE ENGINE SLOWS DOWN OR STALLS THE E.G.R. VALVE IS O.K. IF NOT, REMOVE AND CLEAN OR REPLACE THE E.G.R. VALVE.

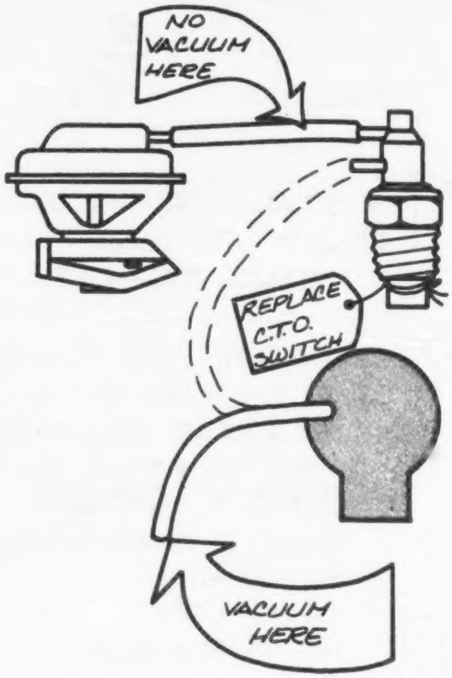


CONNECT A MANIFOLD VACUUM HOSE TO THE THE E.G.R. VALVE.

IF THE E.G.R. VALVE IS O.K., NEXT CHECK THE C.T.O. SWITCH.

① REMOVE THE LOWER VACUUM HOSE ON THE C.T.O. SWITCH.

② INCREASE ENGINE SPEED TO 2000 - 2500 R.P.M. IF YOU FEEL A VACUUM HERE, THAT MEANS WE HAVE VACUUM TO THE C.T.O. SWITCH, BUT NO VACUUM OUT OF IT - RIGHT? THE E.G.R. VALVE STEM DIDN'T MOVE IN OUR FIRST TRY. THIS TELLS US THE C.T.O. SWITCH NEEDS REPLACING.

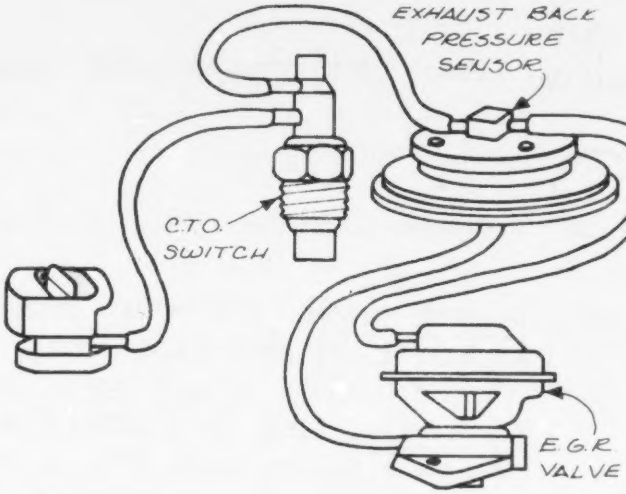


IF NO VACUUM IS FELT IN STEP 2, THE VACUUM AMPLIFIER IS PROBABLY DEFECTIVE. BEFORE YOU BUY A NEW ONE, HAVE YOUR MECHANIC CHECK IT OUT, **OR** GET THE PROPER SERVICE MANUAL FOR YOUR CAR AND FOLLOW THE DIRECTIONS CAREFULLY.

VEC
AUTO BOOK

AGAIN, LET ME SAY THAT THERE ARE A LOT OF VARIATIONS IN E.G.R. SYSTEMS. I CAN ONLY GIVE YOU SOME GENERAL CHECKS AND TIPS.

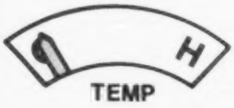
CHECK A SERVICE MANUAL FOR **EXACT** PROCEEDURES. O.K.?


EXHAUST BACK PRESSURE SENSOR
C.T.O. SWITCH
E.G.R. VALVE

LET'S LOOK AT THE E.G.R. SYSTEM THAT HAS THE EXHAUST BACK PRESSURE SENSOR ON IT.

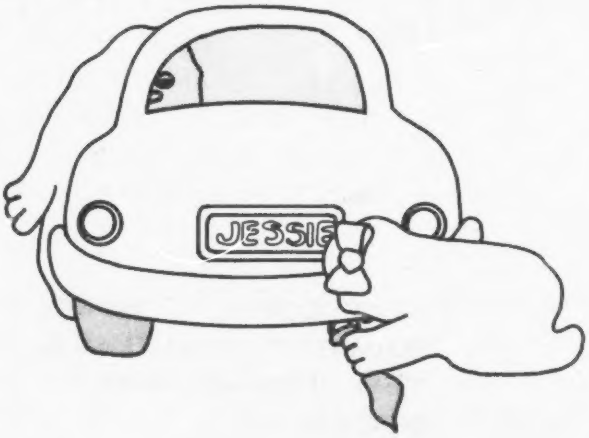
FOR THIS CHECK YOU WILL AGAIN NEED THE HELP OF A FRIEND.

① START WITH A COLD ENGINE.



② START THE ENGINE.
NOTE: MAKE SURE AREA IS WELL VENTILATED.

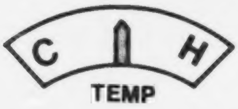
③ HAVE YOUR FRIEND HOLD HIS FOOT OR A WADDED-UP RAG OVER THE TAILPIPE TO RESTRICT - NOT STOP - THE EXHAUST FLOW. YOU WATCH THE E.G.R. VALVE STEM.
CAUTION: USE A CLEAN RAG. SOLVENT OR OIL-SOAKED RAGS COULD CATCH FIRE.



④ AS YOUR FRIEND BLOCKS THE EXHAUST OUT OF THE TAILPIPE, INCREASE ENGINE SPEED TO 2000-2500 R.P.M. THE E.G.R. VALVE STEM SHOULD NOT MOVE WITH THE ENGINE COLD. IF IT DOES, REPLACE THE C.T.O. SWITCH

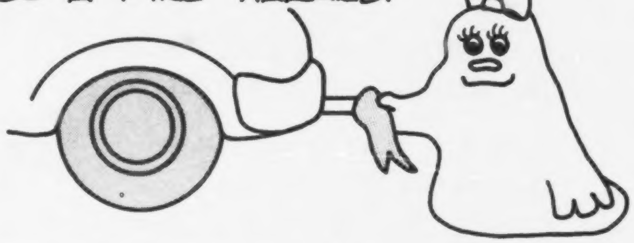
WITH ENGINE COLD, AND EXHAUST RESTRICTED, E.G.R. VALVE SHOULD NOT MOVE.

O.K. NOW LET THE ENGINE WARM UP.



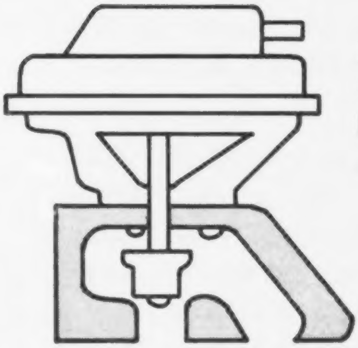
① AGAIN, WATCH THE E.G.R. VALVE STEM.

② HAVE YOUR FRIEND RESTRICT THE EXHAUST FLOW **CAUTION** BETTER TELL THEM NOT TO BURN THEIR HANDS; THAT EXHAUST IS GOING TO BE HOT. WARNING: USE A CLEAN RAG. SOLVENT OR OIL SOAKED RAGS CAN BE A FIRE HAZARD.



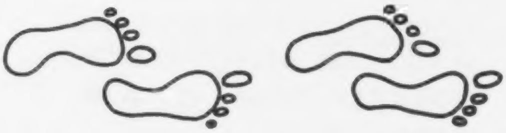
③ INCREASE ENGINE SPEED TO ABOUT 2000-2500 R.P.M.

④ THE E.G.R. VALVE STEM SHOULD MOVE UP.



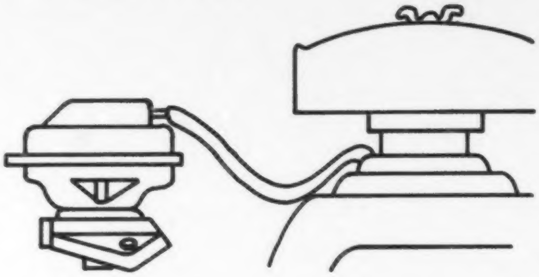
IF IT DOES, YOUR E.G.R. SYSTEM IS PROBABLY WORKING O.K.

IF IT DOESN'T MOVE, I SUGGEST YOU TAKE THE FOLLOWING STEPS —



① CHECK OUT THE E.G.R. VALVE. DO THIS BY APPLYING A SOURCE OF INTAKE MANIFOLD VACUUM, LIKE I SHOWED YOU EARLIER. IF IT OPERATES PROPERLY, GO AHEAD TO STEP ② IF NOT, CORRECT THE PROBLEM BY CLEANING OR REPLACING THE E.G.R. VALVE.

CHECK E.G.R. VALVE BY APPLYING A SOURCE OF INTAKE MANIFOLD VACUUM TO IT.

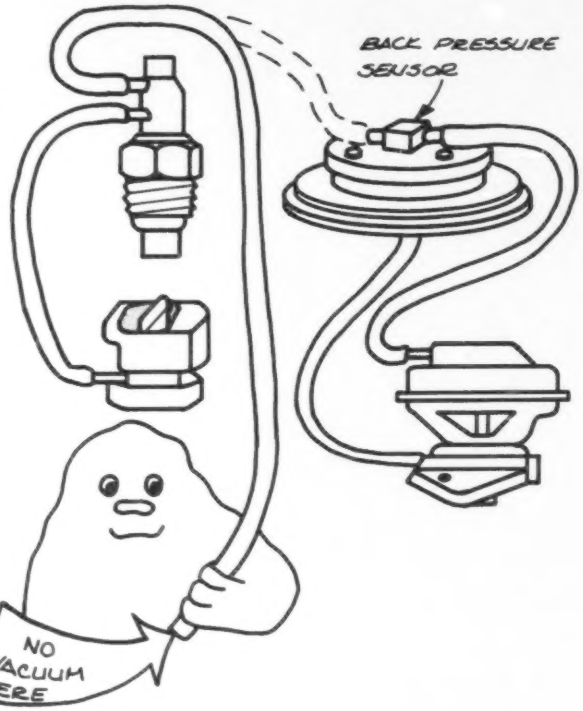


② REMOVE THE VACUUM HOSE FROM THE BACK PRESSURE SENSOR LIKE I'M SHOWING HERE.

③ INCREASE ENGINE SPEED TO 2000 – 2500 R.P.M.

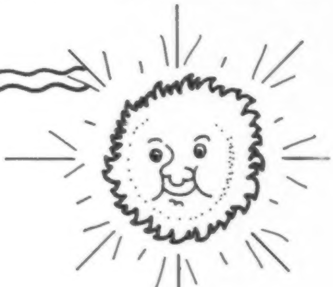
④ IF YOU DO NOT FEEL VACUUM AT THE END OF THE HOSE, THE C.T.O SWITCH IS NOT OPERATING AND SHOULD BE REPLACED.

⑤ IF YOU DO HAVE VACUUM, THE PROBLEM IS IN THE BACK PRESSURE SENSOR. CHECK THE MANUFACTURER'S SERVICE MANUAL IF YOU ARE GOING TO ATTEMPT TO FIX IT YOURSELF. IF NOT, AT LEAST NOW YOU CAN TELL YOUR MECHANIC WHAT IS WRONG AND LET HIM FIX IT.



CAUTION

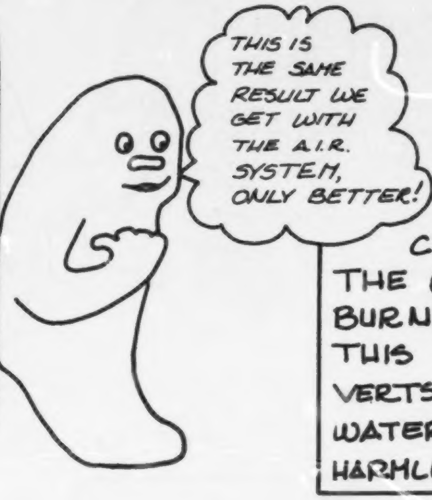
LATE MODEL CARS ARE DESIGNED TO OPERATE WITH E.G.R. PLUGGING THIS SYSTEM OR MAKING IT INOPERATIVE CAN CAUSE THE ENGINE TO PING OR DETONATE. THIS CAN CAUSE EXPENSIVE ENGINE DAMAGE! KEEP THE SYSTEM OPERATING PROPERLY. THIS WILL PREVENT POSSIBLE ENGINE DAMAGE AND KEEP OUR AIR CLEANER.



CATALYTIC CONVERTER SYSTEMS

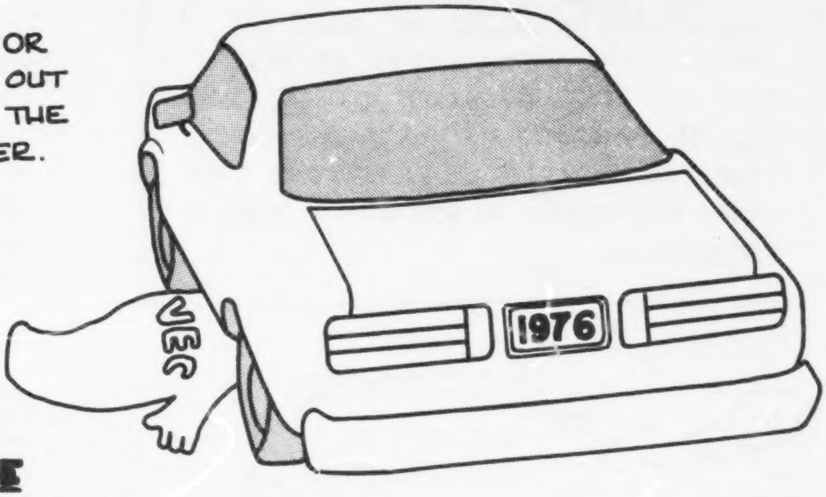
Preceding page blank

HC + CO ARE
OXIDIZED AND
CHANGED TO
WATER VAPOR (H_2O)
AND
CARBON DIOXIDE
(CO_2)


THIS IS THE SAME RESULT WE GET WITH THE A.I.R. SYSTEM, ONLY BETTER!

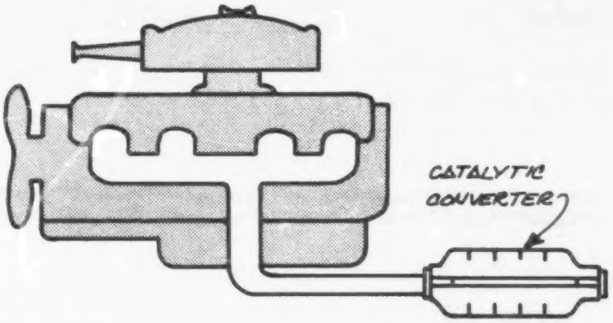
THE HC AND CO THAT ENTERS THE CONVERTER IS BURNED OR OXIDIZED. THIS OXIDATION CONVERTS HC AND CO TO WATER VAPOR AND HARMLESS CARBON DIOXIDE

IF YOU OWN A **1975** OR NEWER CAR, LET'S GO OUT AND TAKE A LOOK AT THE CATALYTIC CONVERTER.



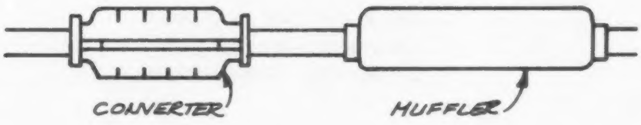
WEAR YOUR OLD CLOTHES BECAUSE YOU'RE GOING TO HAVE TO LOOK UNDER THE CAR.

WARNING: BE SURE TO SET PARKING BRAKE.


CATALYTIC CONVERTER

LOOK UNDER YOUR CAR AND FOLLOW THE EXHAUST PIPE DOWN FROM THE ENGINE. THE CATALYTIC CONVERTER WILL BE LOCATED IN THE EXHAUST PIPE, NOT VERY FAR FROM THE ENGINE.

find it?


CONVERTER
MUFFLER

THE MUFFLER ON YOUR CAR WILL BE LOCATED FURTHER DOWN THE EXHAUST SYSTEM THAN THE CATALYTIC CONVERTER.

THE CATALYTIC CONVERTER IS OFTEN CALLED THE CATALYTIC MUFFLER. THIS IS AN ERROR. THE CONVERTER IS NOT DESIGNED TO QUIET EXHAUST NOISE. IT IS ONLY USED TO BURN UP HC AND CO EMISSIONS FROM THE ENGINE.

ATTENTION

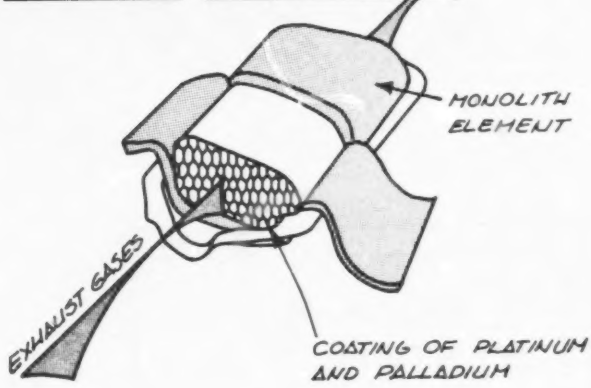
CATALYTIC CONVERTERS ARE not MUFFLERS.

NEXT... YOU SHOULD PULL UP A CHAIR AND I WILL EXPLAIN A LITTLE MORE ABOUT HOW THE CATALYTIC CONVERTER OPERATES, AND WHAT YOU CAN DO TO MAKE SURE IT OPERATES PROPERLY.

FIRST, LET ME SHOW YOU WHAT MAKES UP A CATALYTIC CONVERTER.

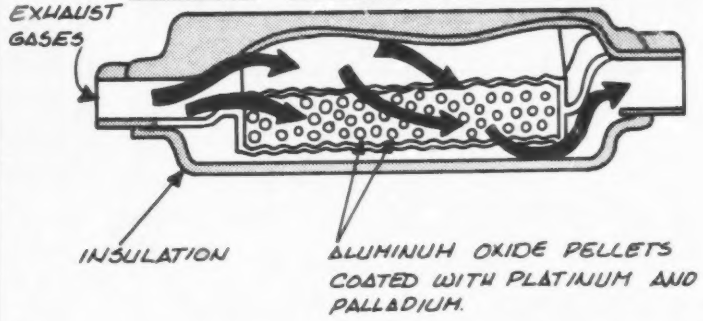
THERE ARE TWO BASIC TYPES OF CONVERTERS. ONE IS CALLED A MONOLITH CONVERTER. (MONOLITH MEANS "ONE PIECE.") THE OTHER TYPE IS THE PELLET STYLE CONVERTER.

MONOLITH CONVERTER


MONOLITH ELEMENT
EXHAUST GASES
COATING OF PLATINUM AND PALLADIUM

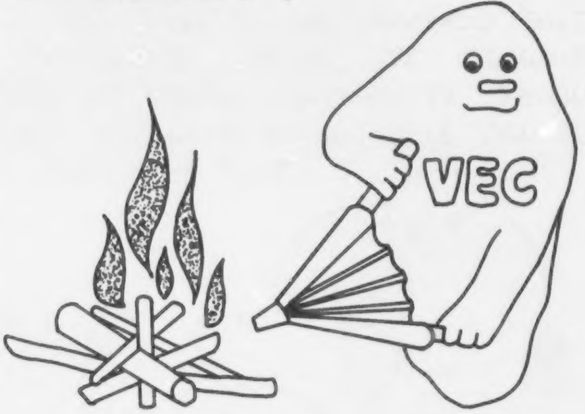
THE IMPORTANT PART IS THE COATING ON THE PELLETS OR THE MONOLITH ELEMENTS. THIS COATING IS PLATINUM OR A MIXTURE OF PLATINUM AND PALLADIUM. THESE ARE THE CATALYST MATERIALS THAT AID IN REDUCING HC AND CO EMISSIONS.

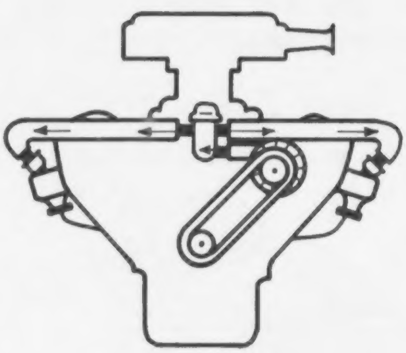
PELLET-STYLE CONVERTER


EXHAUST GASES
INSULATION
ALUMINUM OXIDE PELLETS COATED WITH PLATINUM AND PALLADIUM.

THAT WASN'T BAD, WAS IT? NOW TO THE IMPORTANT PART!

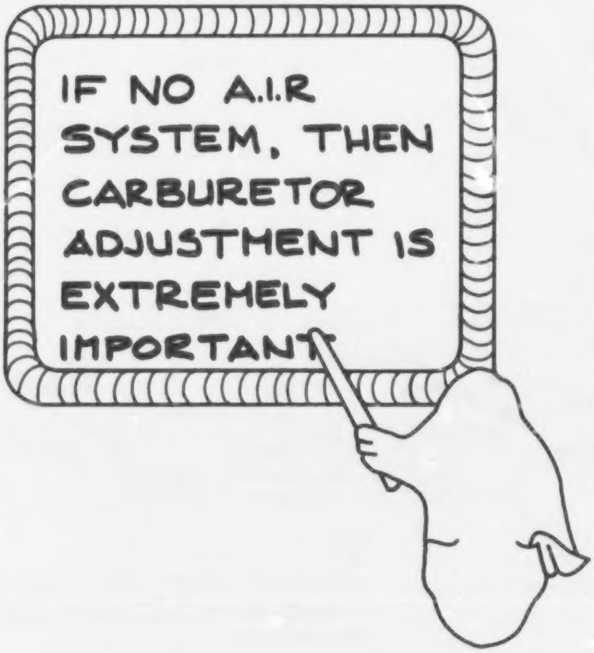
ONE VITALLY IMPORTANT ITEM THESE CONVERTORS NEED FOR PROPER OPERATION IS **OXYGEN.** OXYGEN IS ESSENTIAL FOR ANY BURNING OR OXIDATION.





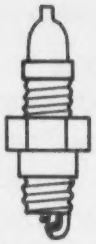
IF YOUR CAR IS A 1975 OR NEWER MODEL AND HAS AN A.I.R SYSTEM, THIS IS WHERE THE EXTRA AIR AND OXYGEN COME FROM FOR THE PROPER OPERATION OF THE CONVERTER.

IF YOUR CAR DOESN'T HAVE AN A.I. R. SYSTEM, CORRECT CARBURETOR ADJUSTMENT IS **EXTREMELY** IMPORTANT.

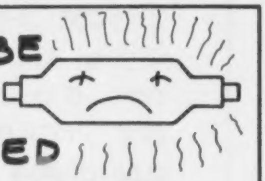


IF NO A.I.R SYSTEM, THEN CARBURETOR ADJUSTMENT IS EXTREMELY IMPORTANT

ANOTHER ITEM YOU MIGHT CHECK: MAKE SURE ALL YOUR SPARK PLUGS AND SPARK PLUG WIRES ARE O.K. A SPARK PLUG THAT IS NOT FIRING WILL NOT ONLY CAUSE YOUR CAR TO RUN ROUGH, BUT WILL WASTE GAS AND CAN RUIN YOUR CATALYTIC CONVERTER.



BAD SPARK PLUGS = **WASTED GAS** / **POOR PERFORMANCE** + **HIGH EMISSIONS** & **MAYBE A RUINED CONVERTER**



ALL THIS RESULTS IN ~

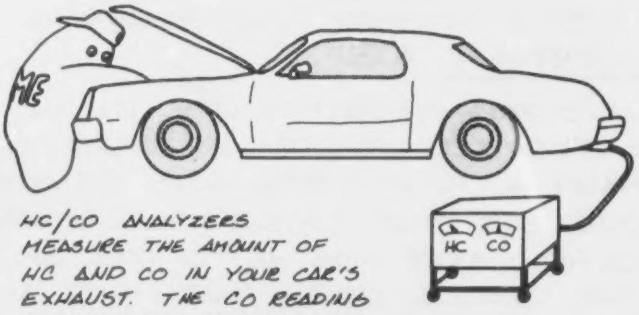
1. LOSS OF MONEY
2. LOTS OF AIR POLLUTION
3. WASTED RESOURCES

NOTICE

DON'T REMOVE THE CATALYTIC CONVERTER AND EXPECT TO GAIN PERFORMANCE OR GAS MILAGE. SINCE THE CONVERTER IS PART OF THE EXHAUST SYSTEM AND NOT PART OF THE ENGINE, IT HAS NO EFFECT ON ENGINE PERFORMANCE, (UNLESS IT'S RESTRICTED.)

ALSO, REMEMBER - THE CATALYTIC CONVERTER BURNS UP HC AND CO IN THE EXHAUST SYSTEM. IT DOES NOT EFFECT ENGINE PERFORMANCE. **HOWEVER,** ENGINE PERFORMANCE DOES EFFECT HOW WELL THE CATALYTIC CONVERTER OPERATES.

THE CORRECT CARBURETOR ADJUSTMENT IS CRITICAL ON ALL NEW CARS FOR PROPER PERFORMANCE AND MINIMUM EMISSIONS.

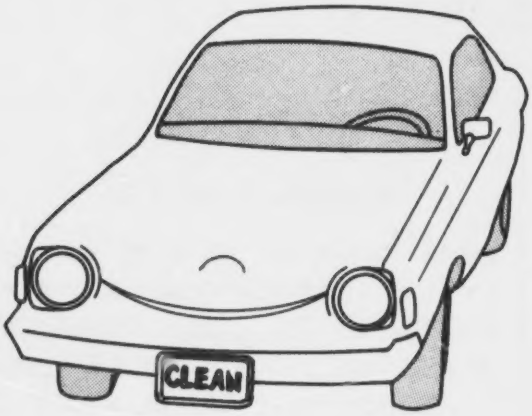


HC/CO ANALYZERS MEASURE THE AMOUNT OF HC AND CO IN YOUR CAR'S EXHAUST. THE CO READING ALLOWS YOUR MECHANIC TO PROPERLY ADJUST YOUR CARBURETOR.

TO PERFORM A PROPER CARBURETOR ADJUSTMENT, AN HC/CO EXHAUST ANALYZER MUST BE USED. THIS EXPENSIVE PIECE OF EQUIPMENT IS USED BY YOUR MECHANIC FOR CARBURETOR ADJUSTMENTS.

IF YOUR CAR HAS A CATALYTIC CONVERTER THE ANALYZER MUST BE USED TO MAKE THE PROPER CARBURETOR IDLE ADJUSTMENT. THIS WILL PROVIDE THE EXTRA AIR (OR OXYGEN) NEEDED FOR PROPER FUNCTIONING OF THE CATALYTIC CONVERTER.

IF YOUR MECHANIC DOES THIS CORRECTLY, THE CATALYTIC CONVERTER WILL WORK PROPERLY AND VERY LITTLE HC AND CO WILL COME OUT OF YOUR CAR'S EXHAUST PIPE – i.e. **CLEAN AIR.**



PSST – IMPROPERLY ADJUSTED CARBURETORS ON CARS WITH CATALYTIC CONVERTERS CAN CAUSE THAT NASTY "ROTTEN EGG" SMELL TO COME OUT THE TAIL PIPE, ALONG WITH A LOT OF H C AND CO.

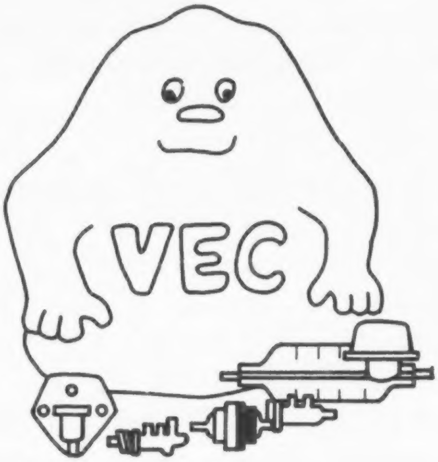
IF YOUR CAR HAS AN A.I.R. SYSTEM WITH PARTS WE DIDN'T TALK ABOUT, I WOULD SUGGEST THE FOLLOWING IMPORTANT STEP:

HAVE THIS SYSTEM CHECKED BY AN AUTHORIZED DEALER OR MECHANIC. MANY A.I.R. SYSTEMS HAVE DEVICES BUILT INTO THEM TO PROTECT THE CATALYTIC CONVERTER. THESE DEVICES ARE TOO COMPLICATED FOR ME TO TALK ABOUT HERE. THEREFORE --- LET THE DEALER CHECK THEM OUT AND KEEP THEM OPERATING PROPERLY.

OTHER
EMISSION SYSTEMS

OTHER EMISSIONS DEVICES YOU MAY FIND ON YOUR CAR

WHAT WE WILL LOOK AT NOW ARE SOME OF THE OTHER EMISSION CONTROL AND/OR EMISSION RELATED DEVICES. SO MANY DIFFERENT DEVICES HAVE BEEN USED THAT IT IS IMPOSSIBLE TO COVER ALL OF THEM HERE. WE WILL DISCUSS ONLY SOME OF THE MORE COMMON DEVICES.



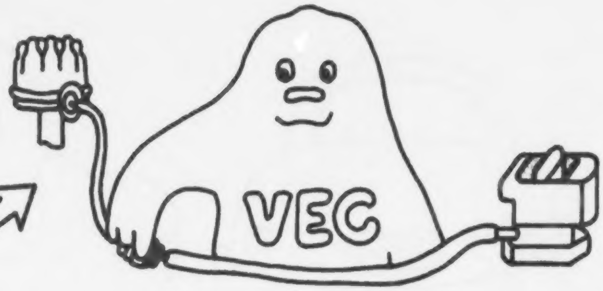
Alta
SERVICE
MANUAL

I WILL SAY AGAIN, THAT FOR A SPECIFIC YEAR AND MODEL CAR, A GOOD EMISSION CONTROL MANUAL OR MANUFACTURER'S SERVICE MANUAL IS THE **ONLY** ANSWER TO SPECIFIC QUESTIONS AND SPECIFIC PROCEDURES.

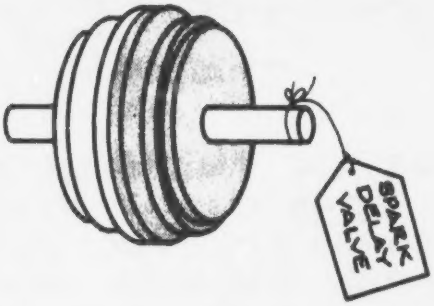
Ⓐ THE FIRST ITEMS I WOULD LIKE TO TELL YOU ABOUT CAN BE CALLED SPARK TIMING CONTROLS.

Preceding page blank

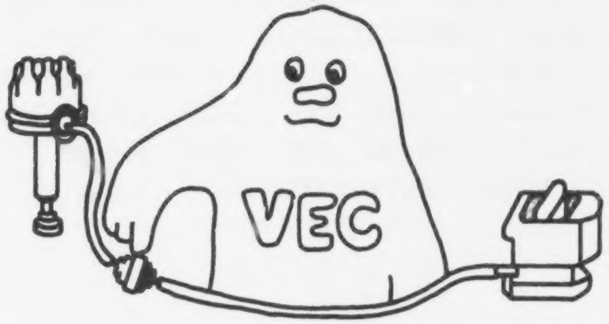
THESE DEVICES ARE FOUND IN THE VACUUM LINE BETWEEN THE VACUUM ADVANCE UNIT ON THE DISTRIBUTOR AND THE CARBURETOR, LIKE I'M SHOWING YOU IN THE PICTURE.



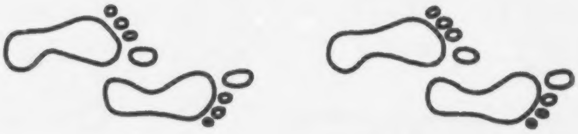
FIRST, I'LL TELL YOU ABOUT THE ONES THAT **DELAY** THE VACUUM ADVANCE UNIT. DELAYING SPARK ADVANCE HELPS TO REDUCE HC AND NO_x.



I'M POINTING TO A SPARK DELAY VALVE THAT IS USED ON MANY FORD PRODUCTS. ONE SIDE OF THIS VALVE IS BLACK AND THE OTHER SIDE IS A DIFFERENT COLOR. THE COLORED SIDE TELLS HOW MANY SECONDS IT WILL TAKE VACUUM TO REACH THE VACUUM ADVANCE UNIT. MANY DIFFERENT COLORS ARE USED.

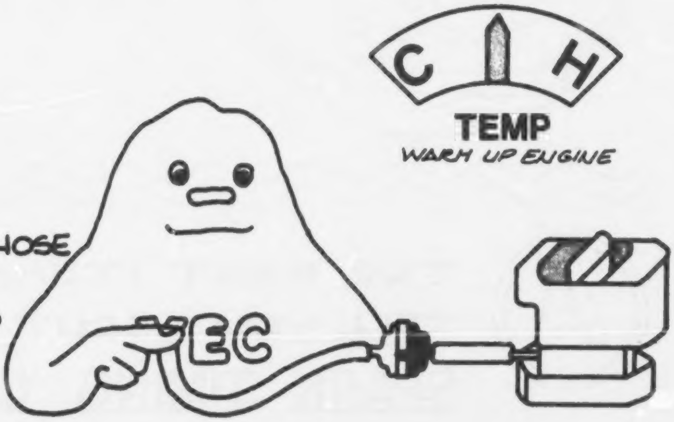


YOU CAN CHECK FOR A PLUGGED SPARK DELAY VALVE BY TAKING THE FOLLOWING STEPS:



1. START YOUR ENGINE AND LET IT WARM TO OPERATING TEMPERATURE.

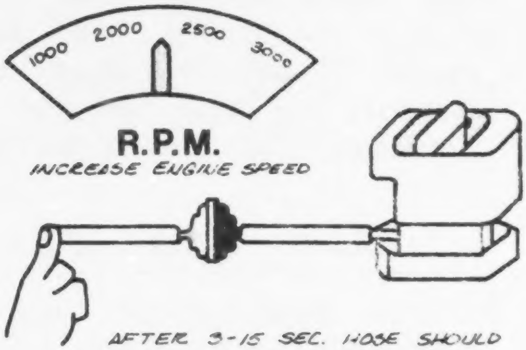
2. REMOVE THE VACUUM HOSE FROM THE VACUUM ADVANCE UNIT AND HOLD YOUR FINGER OVER THE END OF THE HOSE.



Reproduced from best available copy.

3.

SLOWLY INCREASE ENGINE SPEED TO AROUND 2000 - 2500 R.P.M.



AFTER 3-15 SEC. HOSE SHOULD STICK TO YOUR FINGER. DON'T LIFT YOUR FINGER OFF THE HOSE UNTIL THE 3-15 SECONDS HAVE PASSED.

4.

IN A FEW SECONDS (3-15 SEC.) THE HOSE SHOULD STICK TO YOUR FINGER. (THIS MEANS THAT THE VALVE WORKS.)

IF YOU FEEL A STRONG VACUUM IMMEDIATLY ON INCREASING ENGINE SPEED, THE SPARK DELAY VALVE SHOULD BE REPLACED.

5.

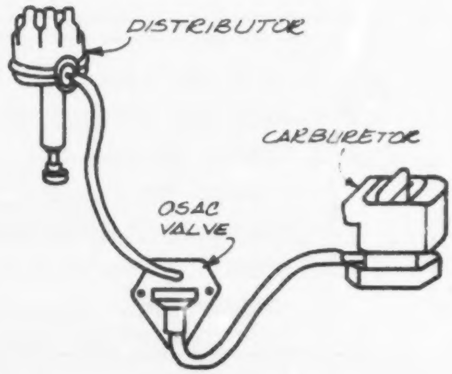
IF, AFTER 30 SECONDS HAVE PASSED NO VACUUM IS FELT, YOU PROBABLY NEED A NEW SPARK CONTROL VALVE. HEAD FOR YOUR FRIENDLY LOCAL DEALER AND BE SURE TO REPLACE IT WITH ONE OF THE SAME COLOR.

NO VACUUM AFTER 30 SECONDS - REPLACE VALVE

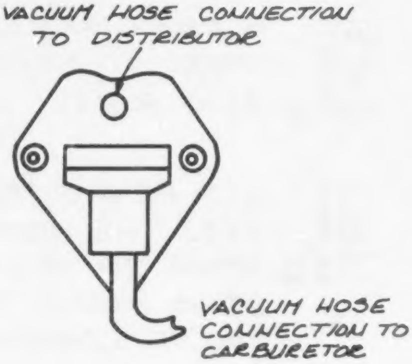
REPLACING A PLUGGED SPARK CONTROL VALVE WITH A NEW ONE WILL PROBABLY RESULT IN MORE MILES PER GALLON.

NEW SPARK DELAY VALVE = $ + CLEANER AIR

LET'S LOOK AT ANOTHER TYPE OF SPARK DELAY VALVE. THIS TYPE IS FOUND ON MANY CHRYSLER PRODUCTS AND IS ABBREVIATED **OSAC.** OSAC STANDS FOR ORIFICE SPARK ADVANCE CONTROL.

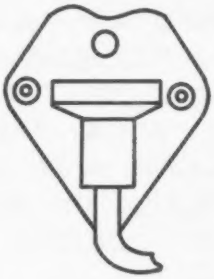


THE PURPOSE OF THE OSAC VALVE IS THE SAME AS THE SPARK DELAY VALVE. THAT PURPOSE IS TO DELAY VACUUM TO THE VACUUM ADVANCE UNIT ON THE DISTRIBUTOR.


VACUUM HOSE CONNECTION TO DISTRIBUTOR
VACUUM HOSE CONNECTION TO CARBURETOR

YOU CAN CHECK THE OSAC VALVE JUST LIKE WE CHECKED THE SPARK DELAY VALVE. HOWEVER, THERE ARE SOME ADDITIONAL THINGS TO CHECK BEFORE YOU CHECK OUT THE OSAC VALVE.

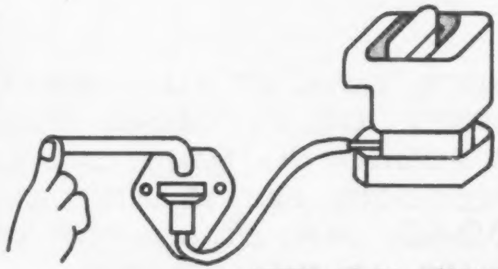
VALVE MUST BE OVER 60°F



1. THE OSAC VALVE SHOULD BE OVER 60°F (NOT COLD.)

DON'T OVERHEAT ENGINE

2. DON'T IDLE THE ENGINE FOR A LONG TIME BEFORE CHECKING THE OSAC VALVE, OR DON'T OVERHEAT THE ENGINE.



AFTER 15-30 SECONDS YOU SHOULD FEEL A STRONG VACUUM ON YOUR FINGER.

3. O.K. AFTER YOU INCREASE ENGINE SPEED TO 2000-2500 R.P.M. IT SHOULD TAKE BETWEEN 15-30 SECONDS BEFORE YOU FEEL A STRONG VACUUM ON YOUR FINGER.

IF:

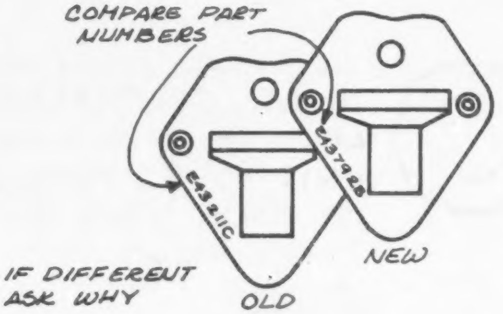
1. YOU FEEL VACUUM IMMEDIATELY YOU PROBABLY NEED A NEW OSAC VALVE.

2. 30 SECONDS HAVE PASSED AND YOU DO NOT FEEL VACUUM, YOU DO NEED A NEW OSAC VALVE

FAULTY OSAC VALVE

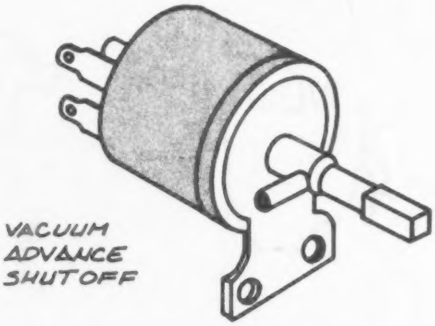
a. WHEN VACUUM IS IMMEDIATE
b. WHEN THERE IS NO VACUUM AFTER 30 SECONDS

IF YOU DO REPLACE THE VALVE, BE SURE YOU GET THE RIGHT VALVE FOR YOUR ENGINE (COMPARE PART NUMBERS ON THE NEW PART AND THE OLD PART.) IF THEY ARE DIFFERENT, ASK THE PARTS DEALER **WHY.**



B

ANOTHER GADGET YOU MAY FIND IN THE VACUUM LINE BETWEEN THE VACUUM ADVANCE UNIT AND THE CARBURETOR IS AN ELECTRICALLY OPERATED VALVE.

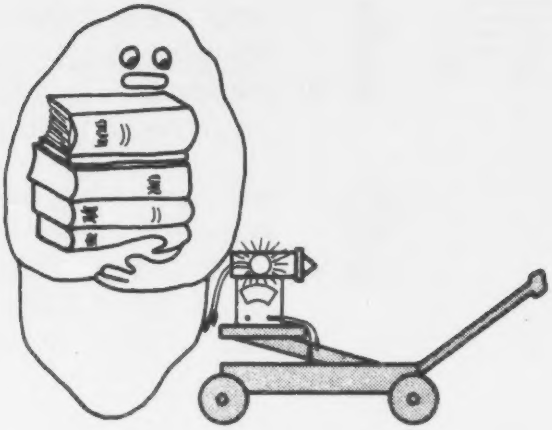


NO VACUUM ADVANCE	1. IN FIRST GEAR 2. IN SECOND GEAR 3. UNTIL A CERTAIN SPEED IS REACHED
VACUUM ADVANCE	1. IN HIGH GEAR 2. WHEN A CERTAIN SPEED IS REACHED

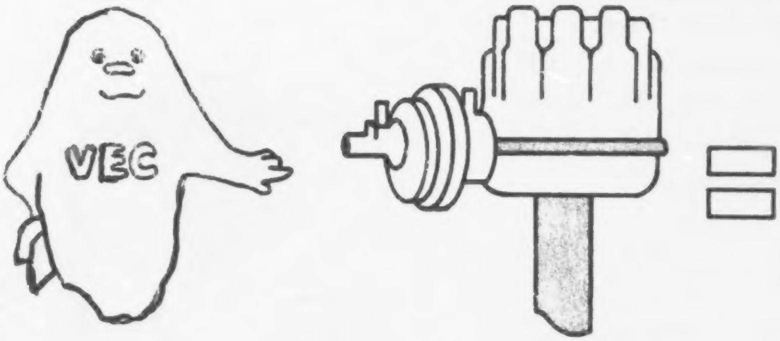
THE **PURPOSE** OF THIS VALVE IS TO DENY VACUUM ADVANCE UNTIL THE CAR GETS INTO HIGH GEAR, OR REACHES A CERTAIN SPEED.

THIS REDUCES NO_x EMISSIONS.

CHECKING OUT THIS DEVICE IS BEST LEFT TO YOUR FAVORITE MECHANIC. THERE ARE SO MANY VARIATIONS AND DIFFERENCES IN THIS SYSTEM THAT SERVICE MANUALS AND GARAGE EQUIPMENT ARE REQUIRED TO CHECK IT OUT PROPERLY.



Ⓒ ANOTHER ITEM FOUND ON MANY CARS IS CALLED A **DUAL DIAPHRAGM VACUUM ADVANCE UNIT** LIKE I'M SHOWING YOU. THE PURPOSE OF THIS UNIT IS TO REDUCE HC EMISSIONS AT IDLE. IT DOES THIS BY "RETARDING" OR CAUSING THE SPARK PLUG TO FIRE LATE WHEN THE ENGINE IS IDLING.



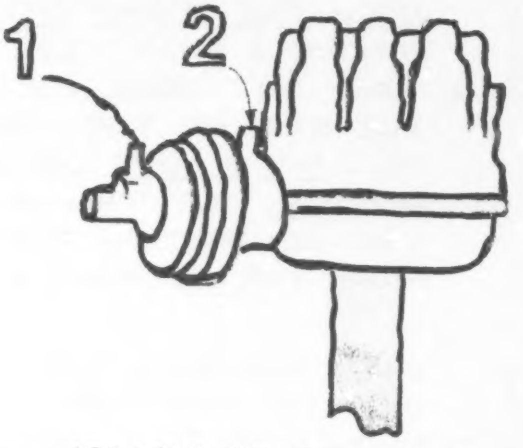
LOW HC EMISSIONS AT IDLE

DUAL DIAPHRAGM VACUUM ADVANCE UNIT

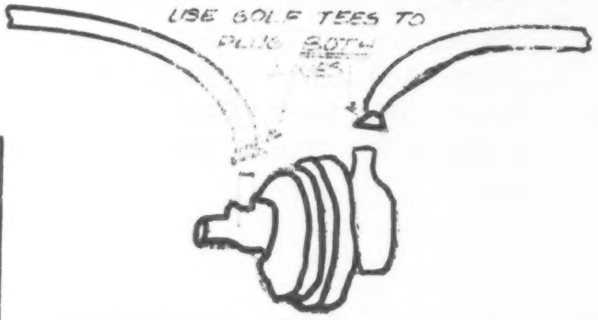
LET'S LOOK CLOSER AT DUAL DIAPHRAGM UNIT

FIRST —

NOTICE THAT THERE ARE TWO VACUUM HOSES ATTACHED TO THE UNIT. IF YOU HAVE YOUR OWN TIMING LIGHT AND SET YOUR OWN TIMING, THERE ARE A COUPLE OF THINGS YOU SHOULD BE AWARE OF.



1. BEFORE YOU SET YOUR TIMING, DISCONNECT BOTH HOSES FROM THE VACUUM ADVANCE UNIT.



CAUTION: KEEP HANDS AWAY FROM FANS, BELTS, AND PULLEYS.

NOTE THIS IS NOT TRUE FOR ALL FOREIGN CARS BETTER **CHECK THE SERVICE** MANUAL FOR YOUR PARTICULAR CAR.

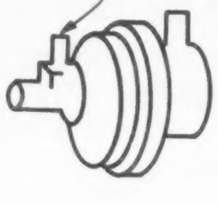
2. PLUG BOTH LINES — GOLF TEES WORK SUPER FOR THIS. DON'T USE SCREWS OR BOLTS. THESE MAKE A MESS OUT OF THE INSIDE OF THE VACUUM HOSE. THIS CAN CAUSE LEAKY CONNECTIONS AND PROBLEMS.

3. NOW GO AHEAD AND SET YOUR TIMING.

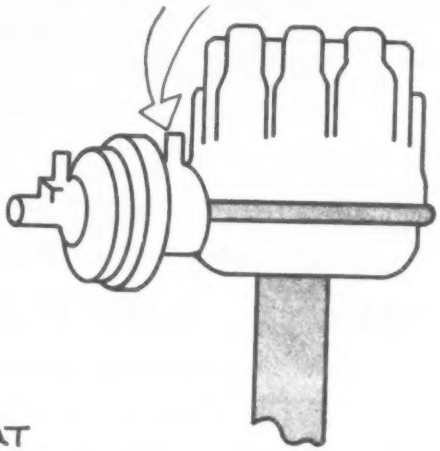
IF YOU FORGET WHICH HOSE CAME OFF WHICH CONNECTION, FOLLOW THESE STEPS —

Reproduced from best available copy.

1. WITH THE ENGINE STILL IDLING, REMOVE A GOLF TEE FROM ONE HOSE. PUT YOUR FINGER OVER THE END OF THE HOSE. IF YOU FEEL NO VACUUM OR VERY LITTLE VACUUM, PUT THIS HOSE ON THE CONNECTION FURTHEST FROM THE DISTRIBUTOR.

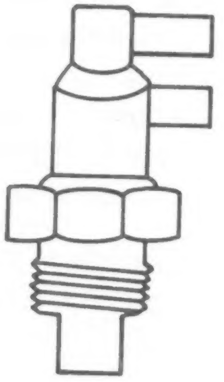


2. WHEN YOU PULL THE GOLF TEE OUT OF THE HOSE YOU SHOULD FEEL A VERY STRONG VACUUM. THIS HOSE GOES ON THE CONNECTION NEAREST THE DISTRIBUTOR. THAT WASN'T TOO DIFFICULT, WAS IT?



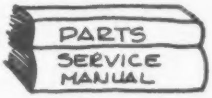
Ⓓ THE NEXT ITEM IS ONE WE ALREADY TALKED ABOUT. THAT ITEM IS THE **CTO SWITCH** THAT WE DISCUSSED IN THE EGR SYSTEM. CTO SWITCHES OR COOLANT TEMPERATURE OVERRIDE SWITCHES HAVE A COUPLE OF NAMES. FOR EXAMPLE:

1. **TVS** OR THERMAL VACUUM SWITCH
2. **PVS** OR PORTED VACUUM SWITCH

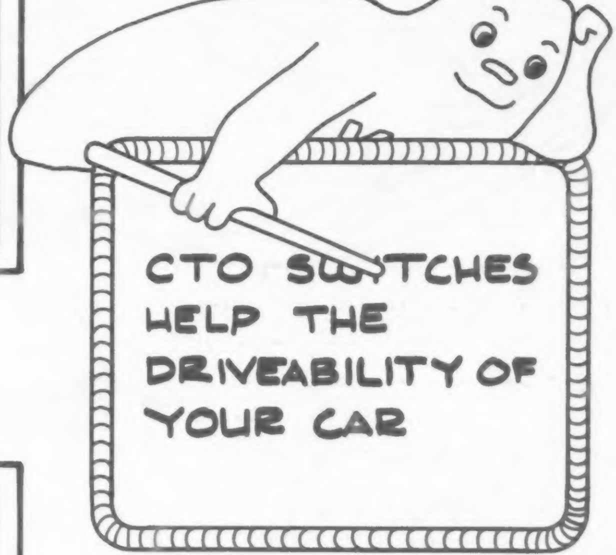


CTO SWITCHES ARE USED IN OTHER SYSTEMS BESIDES THE EGR SYSTEM. I'M TELLING YOU THIS SO WHEN YOU DO LOOK UNDER YOUR HOOD AND SEE A CTO SWITCH YOU DON'T AUTOMATICALLY THINK OF THE EGR SYSTEM.

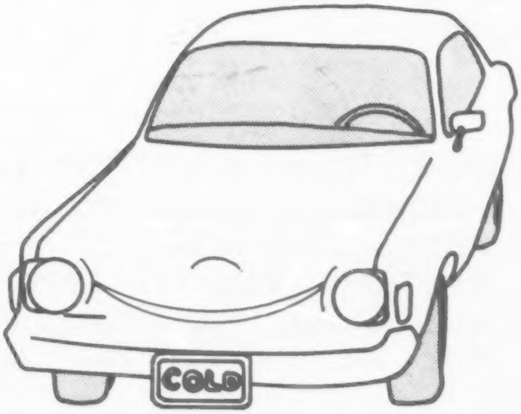
WE ONLY LOOKED AT TWO-PORT (OR TWO CONNECTION) CTO SWITCHES IN THE EGR SYSTEM. THERE CAN BE TWO PORT, THREE PORT, FOUR PORT AND ALL THE WAY UP TO SIX CONNECTIONS ON A CTO SWITCH. LIKE I'VE SAID MANY TIMES BEFORE — A GOOD EMISSION OR SERVICE MANUAL IS NEEDED THESE DAYS.


PARTS
SERVICE MANUAL

CTO SWITCHES ARE USED FOR MORE PRECISE CONTROL OF THE OPERATION OF SOME SYSTEMS, ALLOWING BETTER DRIVEABILITY WHILE REDUCING EMISSIONS.


CTO SWITCHES HELP THE DRIVEABILITY OF YOUR CAR

THROUGH CHANGES IN TEMPERATURE, CTO SWITCHES CAN REGULATE THE VACUUM TO MANY DEVICES OR EVEN SWITCH THEM TO OPERATE ON DIFFERENT KINDS OF VACUUM.



OR, IN OTHER WORDS, THEY ARE IMPORTANT FOR LOW EMISSIONS AND DRIVEABILITY.

WELL, THAT'S IT FOR NOW.
I HOPE I'V SUCEEDED IN EXPLAINING SOME OF THE TESTS AND CHECKS YOU CAN MAKE ON THESE SYSTEMS. ALSO I HOPE I'VE POINTED OUT WHERE AND WHEN YOU SHOULD CONTACT YOUR MECHANIC FOR HIS EXPERTISE AND SERVICES

CLEAN AIR IS EVERYONE'S RESPONSIBILITY AND YOU CAN DEFINITLY HELP IN THIS EFFORT.

APPENDIX

MANUFACTURERS SERVICE MANUALS

Availability and costs of manufacturers service manuals can be obtained by written request to the following addresses. For cars not listed, check with your local dealer. He can provide the address for obtaining manuals.

1. American Motors Corporation

Write to: American Motors Corporation
14250 Plymouth Road
Detroit, Michigan 48232

2. Chrysler Corporation

Write to: Chrysler Corporation
Service Department
P.O. Box 40
Detroit, Michigan

3. Datsun

Write to: Parker Industries, Inc.
609 Deep Valley Dr.
Rolling Hill Estates, California
90274

4. Ford Motor Company

Write to: Helm Incorporated
P.O. Box 07150
Detroit, Michigan 48207

5. General Motors Corporation

Write to: GMC Truck & Coach
Division Printing, Inc.
Dept. GMC
1179 Sylvertis Road
Pontiac, Michigan 48054

6. Honda

Write to: American Honda Motor Company
Incorporated
Automobile Customer Service Dept.
100 West Alondra Blvd.
Gardena, California 90247
213-327-8280

Preceding page blank

7. Toyota

Write to:
Toyota Motor Sales USA, Inc.
2055 West 190th Street
Torrance, California 90504
213-532-5010 - Customer Relations

8. Volkswagen

Write to:
Robert Bently Incorporated
872 Massachusetts Avenue
Cambridge, Massachusetts 02139

ENVIRONMENTAL PROTECTION AGENCY
Technical Publications Branch
Office of Administration
Research Triangle Park, North Carolina 27711

OFFICIAL BUSINESS
AN EQUAL OPPORTUNITY EMPLOYER

POSTAGE AND FEES PAID
ENVIRONMENTAL PROTECTION AGENCY
EPA - 335

SPECIAL FOURTH-CLASS RATE
BOOK

U.S. MAIL

Return this sheet if you do NOT wish to receive this material ☐ or if change of address is needed ☐. (Indicate change, including ZIP code.)

PUBLICATION NO. EPA-450/3-77-043